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Recommendations.

Most of us have heard the story of the man whose experience with an ex-employee had been so unsatisfactory that when the man's name was mentioned in connection with what he mistook for an effort to get him back in his place there was an explosion of impatient protest and an emphatic declaration to the effect that that particular man could never under any circumstances be employed in that establishment again; but who when it had been explained that a recommendation was all that was wanted, so that the man could get a place with another employer, readily signed his name to a letter highly commending the ex-employee. There is a story of a brakeman who was discharged for general all-around good-for-nothingness but who nevertheless took away with him a certificate from the division superintendent stating that he was a man in every way competent and fitted for the duties of brakeman. In a day or two he applied for work on the same division of the same road and got it on the strength of the aforesaid certificate, the division superintendent being a man not without a sense of humor and clearly perceiving that it would be slightly absurd for him to refuse to hire a man who was so highly commended by one whom he knew to be a thoroughly good division superintendent—*i. e.*, himself.

These incidents, whether true ones or not, serve to show the very general sentiment regarding testimonials and references. Men so easily sign them in favor of others whom they would not themselves think of employing.

But there is another side to the matter which perhaps is not as generally understood as it might be and that is, that there are very many causes that may operate to give an employer a bad opinion of an employee without any fault upon the part of the employee whatever.

We all know that too many shops are filled with intrigue and underhanded schemes of all kinds—filled with cliques which are bitterly opposed to each other and always ready to sacrifice the good of the shop or the reputation of any man in it for the sake of a tactical advantage or to do an injury to the opposing clique. In a shop of this kind a good man who may inadvertently get into it is almost sure to make enemies, and the more strictly he attends to his own business and works in the interest of his employers the more likely he is to incur the enmity of one or the other of the cliques or perhaps of both of them. A man in a position of responsiblity is almost sure to find it necessary to take action in the interest of his employers that will be taken as an offence by one or the other or perhaps both of the cliques. If he defeats them and breaks them up his employer may have a good opinion of him, but if the cliques beat the man and drive him out it is usually because the employer is blissfully ignorant of the existence of the cliques, and has been convinced by their representatives that the man in question is no good. Such an employer, if conscientious in the matter of recommendations, would give the man a bad one notwithstanding that he might be the very best man that had ever entered his place.

Again family matters may lead to the same result. There may be one or more utterly worthless relatives of the proprietor on hand to make trouble and to misrepresent the actions and the motives of a man who proposes to do anything, no matter how necessary or advantageous for the establishment, if it is calculated to interfere in any way with a sinecure or to show more plainly the entire superfluity of one of the hangers-on. Here again is a condition which may lead to the best of men getting a bad reputation in at least one shop, a reputation which may possibly prevent him from getting a place in another shop where he would be of the utmost value.

Then, too, it is to be remembered that one man judges another by his own standard. If a superintendent for instance is a mere narrow-minded martinet—a man who assumes (and acts upon the assumption) that every employee wants to do as little as possible and to do that little as badly as possible; if he thinks that the only way to get efficient service out of employees is to browbeat them and to establish a system of espionage and petty, annoying reminders that he is boss and that he has no faith in their intention to do right unless constantly watched and goaded, he will (sincerely enough) think very little of a foreman, for instance, who adopts a different and a more enlightened plan and may refuse to commend such a man because he may really think that the man "has not got backbone enough for an executive position," his own idea of backbone being to be ugly, abusive and generally disagreeable.

One of the leading stockholders in an incorporated company was manager of the business. Though not a mechanic nor at all well informed regarding manufacturing he acted most of the time as superintendent of the factory simply because he could not keep anyone long as superintendent. He had the shop filled with his relatives as foremen and in other positions wherever they could be put to earn more money than they were worth and the combination, partly by reason of their ignorance and partly by reason of their natural depravity and rascality, were simply bleeding the enterprise to death. One man after another who went in there as superintendent discovered that the reason the work cost so much more than it should was because the leading men of the factory held their positions because of blood or marriage relationship to the manager instead of because they were efficient men, and who tried to make changes promptly discovered that his hands were tied and that he could do absolutely nothing for the improvement of the place. Finally a man got in there who by some unsual turn of events did get sufficient authority to enable him to start the factory on the right road. But by a system of the most conscienceless lying and the repeated building up of plausible stories, intrigue finally won and the establishment is at the present time going the road to destruction, defying and setting at naught every well-established principle of successful manufacturing and denying the experience of all who have carried it on. The man who started the regeneration of this shop and who would

have placed it upon a sound basis within the time and with the outlay that he at first calculated and announced to the proprietors would be necessary, could not get a recommemndation from them as superintendent. In fact he would get the opposite of a recommmendation if anyone should inquire about him, but that would only show, as a great many other instances do, that unfavorable as well as favorable opinions of ex-employees are unreliable unless one can know something of the circumstances and especially something of the kind of man who expresses the opinion.

The Steel Combine.

The giant steel organization and our trade relations with Russia continue to be the all-absorbing topics of conversation in the commercial world and machinery men are of course peculiarly interested in both of them. The companies that compose the great steel combination are given as follows in the order of their capitalized amounts:

Carnegie Steel Co.	$160,000,000
Federal Steel Co.	99,745,000
American Steel and Wire Co.	90,000,000
National Tube Co.	80,000,000
American Bridge Co.	70,000,000
National Steel Co.	59,000,000
American Sheet Steel Co.	49,000,000
American Tin Plate Co.	46,325,000
American Steel Hoop Co.	33,000,000
Total	$687,070,000

The general sentiment in the most conservative and best-informed quarters agrees with the position we have previously taken with regard to these combinations —*i. e.*, that the formation of such a company is in itself not a crime nor necessarily prejudicial to the interests of the general public, but at the same time it is pointed out that the power that can be wielded by the men controlling the combination might be used in such a way as to be intolerable and that it will take a good deal of self-control and good judgment together with a wholesome respect for public opinion, perhaps, to enable the men who are to manage it to steer clear of dangerous rocks. The men who control this gigantic organization are also largely interested in railroads and already control and are said to be acquiring other large interests in coal lands. If especially it be found that they as railroad owners favor themselves as coal miners and steel producers to the prejudice and injury of possible competitors they will undoubtedly contribute very much to a rapidly growing public opinion which may easily be goaded into some very radical action with respect to common carriers. The making of steel is not a public function, but the carrying of railroads with their rights of eminent domain and their necessarily monopolistic privileges is a public service and it is almost certain that notwithstanding the fact that the present conduct of some of our greatest monopolies is not strongly opposed no repetition of the methods by which they crushed out competition would be amiably acquiesced in at this time. In short we believe it is generally agreed that the steel company may be so conducted as to be a good thing for the public and at the same time a money-making enterprise for its owners, but that it must be by good business methods and by rendering to the people a fair service in return, not by the methods of the freebooter or the highwayman.

Settlement of the Cleveland Molders' Strike.

A settlement has been finally arrived at between the foundry owners and the molders of Cleveland, so that the long strike there has been terminated. The foundries are to complete their present contracts within a specified time and will then discontinue the payment of the bonus to molders. Places of men leaving for any cause will be filled by members of the Iron Molders' Union, though not necessarily by ex-employees.

The minimum rate of wages is to be 27½ cents per hour for floor and bench molders. Future adjustment of wages is provided for at a fixed date.

The right to operate molding machines is not to be questioned. Arbitrary limitation of output by the molders and arbitrary demands for increased output by the employers are discountenanced. Causes of trouble and friction are to be investigated and no strike or lockout is to be declared pending such investigation.

This strike is notable as being the first in which a bonus has been paid for workmen to take the place of strikers. Men have been receiving $2 per day extra for working in the foundries, which $2 was paid not by the foundry proprietors in whose establishments trouble was going on, but by the National Founders' Association, which took up the fight and has carried it on.

Opening of the Franklin Air Compressor Works.

February 12 witnessed the formal opening of the Franklin Air Compressor Works at Franklin, Pa. Many invited guests were present and the opening was an event in the town, which is situated in the heart of the Pennsylvania oil field. In those regions the rough-and-ready, get-there style of machine shop is the one which the inhabitants look upon as the natural one, and the opening of a modern, well-appointed, clean, well lighted and warmed shop attracted a large attendance in addition to those especially invited.

The shop is one of several enterprises which are associated with the Chicago Pneumatic Tool Company and is intended to furnish that company with the compressors that go with its outfits. Its equipment is strictly modern and we hope to show some of its features in the near future.

United States Consuls Covert and Brunol, writing from France, state that the production of silk in the United States now equals and will shortly exceed that of France. A third, and now apparently successful start in silk culture, was made in this country about thirty years ago.

Commercial Review.

NEW YORK, Monday, Feb. 25.

SUPPLY MARKET AND VARIOUS MACHINE NOTES.

The market for small supplies shows improvement this month, as was to be expected. Trade is experiencing the growth which naturally culminates in the heaviest sales of the year during March. While the demand is hardly as good as it was a year ago, sellers generally have no reasonable ground of complaint.

The combination in the steel trade may be expected to help prices to some extent. There have been few marked changes in values of late in the supply market. Wood screws have weakened somewhat and valves and fittings have just been advanced about 5 per cent. The consolidation of interests in the file trade will probably tend to give firmness to figures, which have hitherto been somewhat unstable in that line. It is believed that the policy of the Nicholson File Company in the administration of its numerous interests will be to keep the market in line for files of the better class.

It is pretty generally understood that the two companies for the acquisition of which negotiations have been under way by the Nicholson File Company are the Arcade File Works, Anderson, Ind., and the Kearney & Foot Company, New York. The Arcade Company was once located at Sing Sing, N. Y., near the arcade of the Croton Aqueduct, from which it derived its name. Since moving to Anderson, Ind., it has built up a large trade. While this consolidation would give the Nicholson Company a large percentage of the output of the country, it will not be a monopoly. The G. & H. Barnett Company, Philadelphia, manufacturer of the well-known Black Diamond files, a few other concerns of some prominence and an indefinite number of smaller manufacturers, are left outside, besides which the imported files play an important part in the file trade.

In connection with the file consolidation it may be mentioned that the Allerton-Clarke Company, dealer in hardware and supplies at 79 Reade street, New York, the members of which denoted in the name are understood to have been principal owners of the Arcade File Works, has just been incorporated. The nominal principal office is 55 Montgomery street, Jersey City; capital, $25,000. Incorporators—Cortland

C. Clarke, Frank H. Lord and Oscar L. Gubelmann.

P. A. Frasse & Co. have recently sold an outfit to a new surgical instrument factory which is to be established by four men who all have been foremen of existing surgical instrument shops. P. A. Frasse & Co. have recently bought out the machinery of the Nyack (N. Y.) plant of the American Bicycle Company.

The Dodge Manufacturing Company has closed a contract for a 500 horsepower rope drive of the Dodge continuous system, and a main jack shaft, for the Hackensack mill of Givernaud Bros., silk manufacturers, Homestead, N. J. It will be driven by a Fishkill Corliss engine.

In issue No. 48, last year, we published an article concerning "Drawbacks on Exports." The Assistant Secretary of the Treasury announces that in the exportation of leather manufactured from belting butts made from imported raw hide, on which duty has been paid at the rate of 15 per cent. *ad valorem*, under paragraph 437 of the Tariff Act, dated July 24, 1897, a drawback will be allowed equal in amount to the duties paid on such imported material used. This is subject to certain regulations.

The plant which the E. P. Allis Company is to erect in Greenfield and Wauwatosa, Wis., will be begun in a month or two. The first contract for the improvement of the tract—that for the artesian wells—has just been let. The general plans for the plant, as prepared by Supt. Reynolds, are said to contemplate the erection within the next few years of at least five large department buildings, side by side, of the same general appearance, and all which will extend at right angles from the main, or erecting shop, which will eventually be 1,000 feet in length and about 60 feet in hight. The structural work will be steel frames and brick walls, and light will be mainly secured by skylights. The tracks for the traveling cranes will be 60 feet from the ground, so that every building will be at least that hight, whether of one, two, three or four stories.

The first buildings to be erected will be the main machine shops and the erecting shop, which will be built with the view of extension at any time as the business may require. At the start, the machine shop will have a length of 600 feet, with a width of 120 feet. The erecting shop will be 186x115 feet, with provision for extension at any time. A system of railroad tracks and traveling cranes will form a network about and through the entire plant, so connected that a car or train of cars can be switched into any building, while a heavy piece of machinery will never get beyond the reach of one of the powerful cranes, no matter to what shop it may have to go in process of construction.

The stockholders of the Westinghouse Electric & Manufacturing Company, February 20, decided to increase the capital stock from $15,000,000 to $25,000,000, and to offer at once for sale $3,000,000 new stock at not less than par. A report submitted showed that on March 31, 1897, the date of last balance sheet submitted to shareholders, the surplus of the company was $2,401,664. December 31, 1900, the surplus balance amounted to $4,693,197, after having in the meantime, from surrent earnings, written off $2,786,719, besides paying interest and dividends on securities. The net shipments, or sales, have been as follows: Year ended March 31, 1898, $4,378,660; 1899, $6,901,760; 1900, $11,963,646. This last figure will be very considerably exceeded during the fiscal year ending March 31, 1901. President Westinghouse says that the greatly increased demand for electrical apparatus has necessitated large additions to works and apparatus, with a corresponding increase in capital acquirements. The company has a cash investment of $750,000 in the British Westinghouse Electric & Manufacturing Company, Limited, preferred stock beside holdings of common and other European investments. It is intended to increase further the facilities of the company. It is rumored that those increases will be such as to add several thousand employees to the force, and that a big modern steel plant is probably contemplated.

A consular report from Bombay, which has come to hand this morning, states that the electric generating plant for applying the power of the Cauvery river in India—an enterprise which we mentioned last week—has been furnished by the General Electric Company. A party of engineers and electricians representing the company arrived with the apparatus. The electric power will be conducted across the country to the Kolar gold fields. This plan is attracting considerable attention, not only from the fact that it is American, but also because it is a new departure in gold mining.

The declared values of exports of machinery from the United Kingdom for the calendar year 1900 were £19,621,557, as compared with £19,650,881 in 1899, £18,380,076 in 1898, £16,282,085 in 1897, and £17,036,899 in 1896. The exports of various kinds of machinery to the United States for the years 1899 and 1900 were as follows:

	1899	1900
Locomotives	£ 3,017	£ 909
Agricultural steam engines	4,815	448
Other steam engines	2,673	33,528
Agricultural, other than steam engines	1,165	5,947
Textile	365,424	648,639
Mining	1,960	360
General	80,336	108,459

Sir Christopher Furness, the well-known ship owner and engine builder, at the annual meeting, February 20, of Robert Stephenson & Co., said that the exports of engines from the United Kingdom were decreasing and the exports from the United States were increasing at a very marked rate. It was announced that the works at Newcastle-on-Tyne would be transferred to Darlington, 18½ miles south of Durham, in order to secure cheaper land for extension.

The American Bridge Company has received a contract for the steel work for the electric power plant, to go to Ultimo, New South Wales, Australia.

The Grecian Government has conceded to American capitalists the development of the emery mines at Naxos. The minimum annual production is estimated at 7,000, tons at 116.5 francs (about $6) in gold per ton.

The thirty-eighth international machinery fair will be held at Breslau June 6, 7, 8, next. Admission for goods may be obtained up to March 31. For application blanks, address: "Maschinen-Austellungs und Markt Commission zu Breslau X, Mathiasplatz 6, Breslau, Germany."

CHICAGO MACHINERY MARKET.

One statement made respecting the Western market for machine-shop supplies is that large orders are notably numerous. Salesmen do comparatively little work but the footings are satisfactory. There are a few minor notes in the symposium of views obtained this week about trade, the minority speaking of business as moderate. But the mass of evidence is to just the opposite effect. Reports of building permits for the year to date show heavy gains over a year ago and a fair proportion of this prospective work consists of factory construction. It does not run especially large in the direction of iron-working plants, but is nevertheless rich in trade for the makers and sellers of belting, shafting, pulleys and general shop equipment. In Chicago locally several buildings for manufacturing purposes in a small way will be erected this spring, and there is a fair amount of shop enlargement and removal work in sight. In the country, among prospective plants to be built, are several cement works.

For shop tools the year to date has been quite active. Jobbers during the past six weeks have been stocking up quite freely, completing broken assortments and preparing with confidence for a large spring trade. The extent of this spring trade will not be made manifest for several months and the jobbing trade is not therefore an accurate index of actual consumption. But there is a trade direct with the consuming manufacturers and it is gratifyingly large. There is every indication that the degree of activity in Western shops is fully up to the spur of a year ago. This is shown not only by the large inquiry and sale of tool and shop supplies, but by the large composition of material. The Western iron and steel markets are attaining an activity to which they have been strangers since the boom of two years ago. It is difficult to procure steel bars in this mar-

ket for shipment within three or four months, and the rule is that buyers of steel material on annual or long-time contracts are specifying for their materials faster than their contracts call for. Shop supplies consumed in this heavy assimilation of material naturally share in the activity.

The Chicago office of the Norton Emery Wheel Company has sold during the past six weeks more emery wheels than during any previous four months in their existence here. The office force works until nine o'clock in the evenings filling orders. There are very few manufacturing plants in the West that are not busy and not a few are employing more men than a year ago.

CINCINNATI REPORT—SOME RESULTS OF BUSINESS MEN'S TRIP SOUTH.

Your Cincinnati correspondent had occasion in a previous letter to correct an impression that seemed to prevail in the East anent the Cincinnati and Western situation in machine tools, suggesting a very depressing condition of things generally out this way, and investigation found the situation correct among a few of the smaller manufactories but utterly untrue as to the majority and the more representative ones. To-day another situation confronts the same manufacturers; but of this one, it may be said, this sentiment is without dissent so far as the writer is aware.

The action of Secretary Gage in the matter of Russian retaliatory duties stirred these manufacturers to the exploding point and at a meeting of the Manufacturers' Club a few days ago a committee consisting of Messrs. Murray Shipley, Jr., of the Lodge & Shipley Machine Tool Company; Thomas P. Egan, of the Fay, Egan Company, and Robert J. Morgan, of the United States Printing Company, was named to draft appropriate resolutions. That committee met at the Business Men's Club, Thursday, February 21, and in a few minutes expressed their ideas in a paper which was sent to President Search and Secretary Wilson of the National Association of Manufacturers, to the representatives of the government in both branches and published broadcast throughout the country.

It is hoped that in this way relief may be soon obtained, else many valuable orders from Russia may have to be cancelled or otherwise lost. The burden falls particularly heavily on the manufacturers of this portion of the United States because of the immense business developed in Russia within the last two or three years by judicious methods in lines which the Russian needs. One of the largest manufacturers of machine tools in this section and at present actively engaged in an effort to bring about the rescinding of the governmental order has the following to say on the situation: "While there is no question that the duty, such as is stated to have been added by the Russian Government to all American manufactured articles, would put us to a great disadvantage, and that during the next ten years of continued favorable conditions exporting to Russia this country would do an enormous business, at the same time we think it behooves us to move exceedingly cautiously and diplomatically rather than hastily and boisterously." Unquestionably the situation is more complicated than appears on its face and a wise solution of the matter will doubtless carry great weight with other countries than Russia.

Mr. A. H. Tuechter, of the Cincinnati Machine Tool Company, is confident that some united effort will be made on the part of the manufacturers to convince the government that another way out of the difficulty should be immediately found. Says Mr. C. F. Mayer, of the Rahn-Mayer-Carpenter Company: "We need the foreign trade and the Washington authorities should at the earliest possible moment bring about the same reciprocal conditions with Russia as existed before the late retaliatory measures adopted by that country."

Returning to foreign conditions, and aside from the situation that confronts the manufacturers in the Russian field, it may be said that very little new foreign business is being booked. But the domestic demand in machine tools and allied lines has increased steadily since the first of the year and a consensus of opinion from the larger and more representative manufacturers warrants your correspondent in predicting that more goods will be sold in this country this year than in any previous one within a decade.

One must not lose sight in this connection of the remarkable increase in demand for electric power machinery. There is an especial activity in the smaller motor and generator trade. President George Bullock, of the Bullock Electric Manufacturing Company, who was a valued member of the party which spent ten days touring the South, was very much interested in the possibilities presented at Knoxville, Tenn.; Columbia, S. C.; Gaffney, N. C.; Augusta, Ga.; Macon, Ga.; and other points in the way of increased opportunities for establishment of electric power machinery. At a number of Southern points generating stations are being equipped, utilizing rare possibilities offered in improved waterways and particularly in the direction of improving the power in the big cotton-mill plants. Mr. Bullock's company, as an indirect result of the trip, is in correspondence with a number of projectors of these enterprises and it looks as though the South was going to be one of the most profitable fields in that new line. Francis E. Rainey, of London, England, another member of the party, made some interesting investigations. He expects to place several good-sized orders for machine tool and electric power apparatus ere his return. A few out of many important orders just taken by the Bullock Electric Manufacturing Company are the following: The Aberdeen "Journal," Aberdeen, Scotland, one 30 horse-power teaser equipment; Montreal Water and Power Co. of Montreal, Canada, one 400 horse-power three-phase motor (this is the fifth or sixth order); Brown & Sharpe Company, Providence, R. I., four type N motors; Buffalo "Evening News," one 70 horse-power type H motor; Glasgow "Evening News," Glasgow, Scotland, three motor generators, teaser pattern; London "Daily Express," three motor generators, same pattern.

As indicated in the opening paragraph of this letter, foreign trade is practically at a standstill from the Cincinnati viewpoint, but the committee having the Russian-duties matter in hand confidently feel that ere this report appears they will have received such substantial assistance from their own State and national representatives and the National Association itself, as to have practically removed the trouble. An upward tendency is observed in the boiler market, and there is a good and steady demand for pumping machinery.

Quotations.

NEW YORK, Monday, Feb. 25.

The pig-iron market is more active, with a strengthening tendency to prices.

Pennsylvania Pig Irons, Jersey City Delivery:

No. 1 X foundry	$15 65 @ $16 50
No. 2 X foundry	15 25 @ 15 50
No. 2 plain	14 50 @ 15 00
Gray forge	13 50 @ 14 65

Alabama Pig, New York Delivery:

No. 1 foundry, or soft	15 00 @ 15 50
No. 2 foundry, or soft	14 50 @ 15 00
No. 3 foundry	14 00 @ 14 50
Foundry forge, or No. 4	13 50 @ 14 00

Bar Iron—Base sizes—Refined brands, mill prices on dock, 1.50 @ 1.60c.; from store, 1.75 @ 1.80c.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. upward.

Machinery Steel — Base sizes — From store, 1¾ @ 2c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½ @ 2¾c.

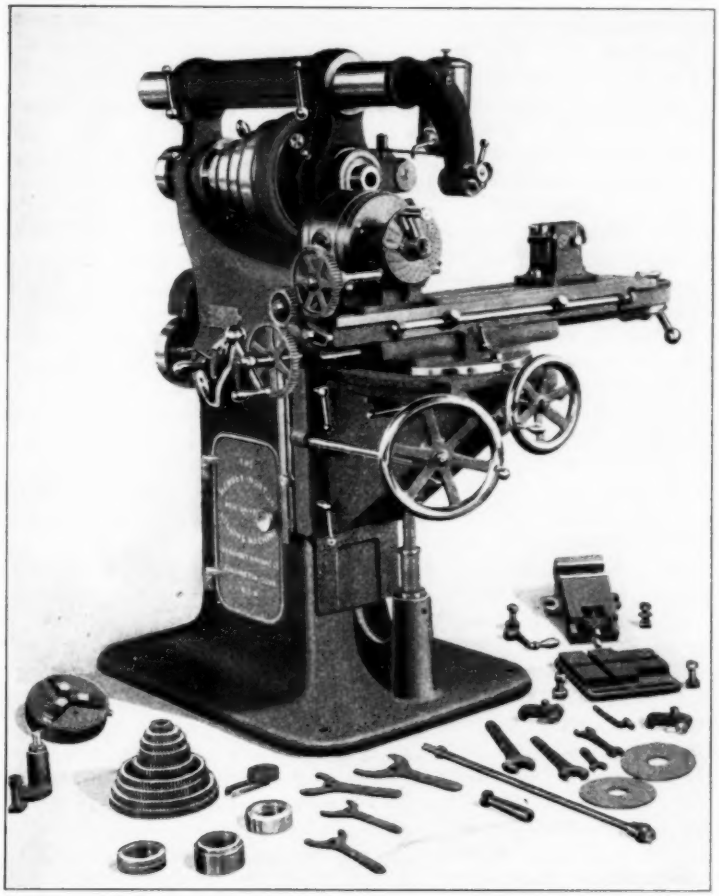
Copper—Lake Superior ingot, 17c.; electrolytic, 16⅝c.; casting, 16½ @ 16⅝c.

Pig Tin—27c., for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ extra for carloads.

Spelter—4.00 @ 4.05c., New York.

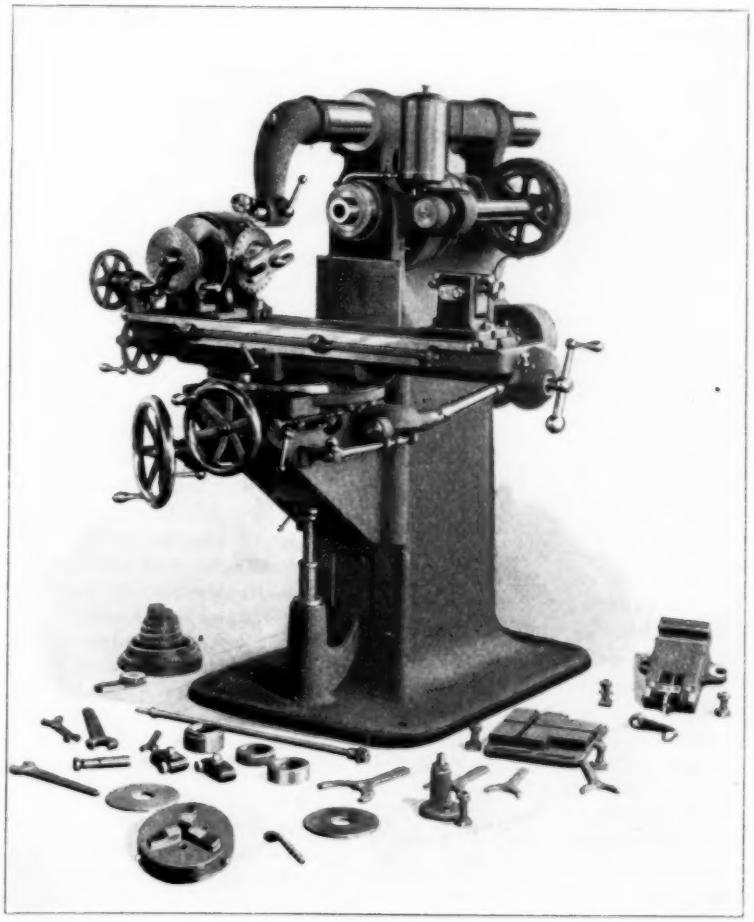
Antimony—For 5-cask quantities Cookson's is about 10½ @ 10⅝c.; Hallett's, 9c.; Italian, Hungarian and Japanese, 8¾c.



The Hendey-Norton Universal Miller.

We give herewith two views of a newly designed vertical milling machine, which, while it conforms in its principal features to what has now become a recognized type, nevertheless has features which are peculiar to itself. The most notable of these perhaps is the application of the Norton device to the feed mechanism by means of which not only a very great range of feed is obtained, but any rate of feed is instantly obtainable by the simple movement of a lever, a table being given which shows the rate of feed in decimal parts of an inch per revolution of the spindle. Gears for obtaining this motion are in this case placed within the column of the machine and the plate above the lever, which gives the rate of feeds is swiveled at one end, so that by swinging it upward to the left an opening is exposed through which the gearing can be seen or oiled when necessary. The shaft which is driven by this internal mechanism carries a gear at its outer end from which motion is derived and carried through other gears, giving further ranges of feed, there being a total of eighteen different rates varying from 0.003 inch to 0.160 inch per turn of the spindle. There is an automatic vertical feed for the knee, an automatic feed for the saddle upon the knee, and of course the usual platen feed at any angle. All these feeds are effected by mechanism, which, so far as practicable, is placed where it can be seen and adjusted, automatic stops being provided for each feed in both directions. For the platen feed tappets are fastened upon a rod extending along the front of the platen, which rod can be moved lengthwise by means of a knurled nut or collar near one end for the purpose of a fine adjustment, and such fine adjustment is in fact provided for all feed stops. A double or telescopic screw is used for raising the knee, so that no hole has to be made through the floor, the smaller screw rotating within the larger one up to the limit of its motion, after which the larger screw revolves for the balance of the distance. The thrust is carried upon a ball bearing.

The dividing head is new in design, the worm shaft being at the bottom and journalled in an eccentric which is so arranged that it not only permits the worm shaft to be disengaged from the worm when it is desired to index rapidly by means of the plate placed on the dividing spindle, but this eccentric provides also the means of adjusting the worm to the wheel to compensate for any wear that may take place and eliminate lost motion. The worm shaft is driven by helical gears from the horizontal shaft seen at the left of the platen. Three bolts pass entirely through the dividing head from side to side and can be clamped rigidly, so that the head is very securely held in any position. The



THE HENDEY-NORTON UNIVERSAL MILLING MACHINE.

spiral head spindle can be depressed 15 degrees below the horizontal and swung 15 degrees beyond the vertical. The overhanging arm is clamped by means of bushings which are fitted to the bolts that pass through the uprights from side to side, these uprights not being split open, the builders considering that this is an advantage, not only to the user of the machine but to the builder as well, as they are not bothered by the alteration of form resulting from the springing which usually takes place when a casting of this nature is cut open at a bore. Ample provision is made for taking care of the oil or other lubricant, there being channels alongside of the head- and foot-stocks and arrangements for carrying the lubricant into a suitable vessel at the end of the platen. Much attention has been paid to securing ample bearing surface for the spindle and for all the slides; the spindle is finished by grinding, and is fitted to phosphor-bronze boxes, which are tapered to permit wear to be taken up by endwise adjustment—the same arrangement as is found in the latest of the smaller-sized Hendey-Norton lathes.

The spindle is of hammered steel, is hollow, and has a No. 10 Brown & Sharpe taper. There is a hole through it 1 1-16 inches diameter. The driving cone is for a 2¾-inch belt, its largest step is 10¾ inches diameter, and the back gears are in the ratio of 5 to 1. All feed motions are provided with the usual micrometer graduations. The vise has a graduated swivel base, and provision is made for readily removing the vise from this base, when the same base, placed under the swivel head, enables it to be set at any angle. The footstock center can be raised vertically or set at any required angle in the vertical plane.

The machine is built by the Hendey Machine Company, Torrington, Conn.

Interchangeable Gearing.*

BY WILFRED LEWIS.

It is well understood that the teeth of gears may be varied indefinitely in shape, provided that their forms are generated by rolling something on the pitch-line of the gear-wheel. This describing outline may be a straight line, circle, a logarithmic spiral, or anything else that will roll, but it cannot be of a shape that will not roll continuously in contact on the pitch-line of the gear-wheel as far as may be necessary to form the tooth profile.

Much attention has been paid to the forms best adapted to various combinations of teeth, with a view to engaging as many teeth as possible in action, and increasing the arc of recess over that of approach for the sake of efficiency and smoothness in running. When such gears are made in pairs, to run only with each other, no reason may at first appear why the forms of their teeth should not be determined by these considerations alone, but sooner or later the patterns or cutters made especially for a certain combination of gears will surely be wanted for other conditions to which they do not particularly apply, and then it will be regretted that the teeth were not shaped for a larger range of usefulness. To be sure this would involve a partial sacrifice of the advantages originally sought, but when one pattern or cutter can be made to serve almost as well as two or three, it does not pay to be too critical and particular about the fine points mentioned, the importance of which I believe has been largely overestimated. Of course, it is better that the arc of recess should be longer than that of approach, to reduce friction and drive as nearly as possible at right angles to the line of centers, and it is also desirable, for the sake of smoothness in running, to have a long arc of action, to which the arc approach contributes as well as the arc of recess, but a gear-wheel for general use may drive or be driven, and its arcs of approach and recess should, therefore, not be very different. It is also admitted that obliquity of action has something to do with the efficiency of gearing, but the question arises, how much is efficiency affected thereby? For a long time involute teeth were avoided by some builders because of the thrust along the line of centers, which the early text-books pointed out as causing so much additional and unnecessary journal friction, and instead of involute forms a cycloidal system was quite generally adopted, in which the describing circle had a diameter one-half that of a twelve-toothed pinion. In this system the obliquity of action varies along the path of contact from zero at the pitch-point to about 23 degrees at the end of a rack tooth, or 20 degrees at the end of a pinion tooth, making the general average of obliquity about 11 degrees.

Along with this system arose the 15-degree involute system, for which Prof. Willis designed his odontograph, and a 14½-degree system, for which the excuse has been made that the angle is easily laid off because its sine is practically ¼. But there is no advantage in this over 15 degrees, which may be quite as easily and more accurately originated and probably the only advantage to be claimed is on the ground of thrust against the wheel centers.

It is readily seen that this thrust on centers is proportional to the tangent of the obliquity, which for 11 degrees is 0.194; for 14½ degrees, 0.259, and for 15 degrees, 0.268; but these figures by no means represent the increase in pressure on journals due to the obliquity, because combined with the thrust there is always a normal driving pressure far greater in amount; and, it may be asked, what are journals for if not to take pressure in any direction? Obviously, the pressure on journals for different degrees of obliquity is measured by the secant of the angle, and not by its tangent, and the three systems should, therefore, be compared as follows:

11°	cycloidal, secant 11°	= 1.0187
14½°	involute, secant 14½°	= 1.0329
15°	involute, secant 15°	= 1.0353

The differences in journal pressure for these systems are therefore very slight, and their differences in efficiency are still less, because, as demonstrated by George B. Grant some years ago, the obliquity of action in involute gearing has no effect whatever upon the friction loss in the teeth themselves. The sliding diminishes at the same rate as the pressure increases, and the loss in effect, whatever it may be, is wholly due to journal friction.

The practical consideration of cost demands the formation of gear-teeth upon some interchangeable system.

The cycloidal system cannot compete with the involute, because its cutters are formed with greater difficulty and less accuracy, and a further expense is entailed by the necessity for more accurate center distances. Cycloidal teeth must not only be accurately spaced and shaped, but their wheel centers must be fixed with equal care to obtain satisfactory results. Cut gears are not only more expensive in this system, but also when patterns are made for castings the double curved faces require far more time and care in chiseling. An involute tooth can be shaped with a straight-edged tool, such as a chisel or a plane, while the flanks of cycloidal teeth require special tools, approximating in curvature the outline desired. It is, therefore, hardly necessary to argue any further against the cycloidal gear-teeth, which have been declining in popularity for many years, and the question now to be considered is the angle of obliquity most desirable for interchangeable involute teeth.

The importance of this question was impressed upon me about fourteen years ago, at which time Wm. Sellers & Co. contemplated a change from the cycloidal system above described to an involute of which the obliquity was to be determined. A careful investigation of the subject in all its aspects then led me to the conclusion that to be entirely satisfactory between the limits of a twelve-toothed pinion and a rack an obliquity of 22½ degrees was required, but in view of the fact that twelve-toothed pinions would more frequently engage other gears than racks, an obliquity of 20 degrees was finally adopted. This increase of 5 degrees over common practice then seemed so radical a departure from all previous experience that it was undertaken with some hesitation and the apprehension of a return later on to a more conservative amount, but the only regret has been that the larger angle was not adopted, without regard to any preconceived notions. By common consent the addendum distance on all gear-teeth is between 0.3 and ⅓

*A Paper read before the Engineers' Club of Philadelphia.

of the pitch, 0.3 pitch being used for circumferential pitches, and $\frac{1}{n}$ (n being the number per inch) for diametral pitches. The firm of Wm. Sellers & Co. uses former in both cases, but the general tendency seems to be the other way, on account of its convenience. $\frac{1}{n}$ is equivalent to $\frac{p}{\pi}$ or 0.3283 p, and the difference is, therefore, slight. Occasionally there is some discussion about the merits of long and short teeth, shorter teeth being advocated for their greater strength, and in certain combinations it is quite possible to use them, but in an interchangeable system the addendum must be long enough to insure an arc of action that will safely cover the pitch in all cases. It is, therefore, not thought desirable to suggest a change in this well-established particular.

The difficulty encountered in the use of involute gearing of common obliquity—14½ or 15 degrees—is known as interference. This is most apparent between racks and pinions, and is due to the path described by the point of the rack tooth crossing the involute face of the pinion near the base-line. A very important part of the acting face of the pinion must then be cut away to clear the rack at the loss of a large part of the arc of action, or the end of the rack tooth must be rounded, thus destroying its claim to the advantages of the involute system and giving it a mongrel character. To avoid this defect, which occurs in the common systems to all pinions of less than thirty teeth, it is necessary to increase the obliquity, letting

a = addendum in terms of the pitch.

α = obliquity.

n = smallest number of teeth to engage with a rack without interference.

Then it can be shown that $\sin.^2 \alpha = \frac{2\pi a}{n}$ (1); and assuming $a = 0.3$ and $n = 12$, we have $\sin.^2 \alpha = \frac{\pi}{20} = 0.15708$, whence $\alpha = 23° 19'$.

Making $\alpha = 20°$ and $a = 0.3$, as in the Sellers system, we have $n = 16$, and it has been found by experience that the interference is noticeable between twelve-toothed pinions and such gears as they frequently engage, of from thirty to sixty teeth.

Letting $a = 0.3283$ in equation (1), we have $\sin.^2 \alpha = \frac{2}{n}$, from which $n = 30$. The angle 22½° is suggested as a convenient one to adopt, being a quarter of the quadrant, and for this it is believed the interference between a twelve-toothed pinion and a rack will be practically imperceptible. For $a = \frac{p}{\pi}$ we shall then have $n = \frac{2}{\sin.^2 22\frac{1}{2}} = 13.35$; and for $a = 0.3$, $n = 12.87$.

The pressure on journals will be increased to secant 22½° = 1.0824, which is only about 5 per cent. more than usual.

The arc of action will always cover the pitch by a margin of 0.3 to 0.6 thereof, and it will vary but little in extreme cases.

The wear on the teeth of pinions will be less concentrated at the base line, and by avoiding interference, their arc of action is actually increased. It may be urged that the whole load is necessarily concentrated on a single tooth, and without denying this, I maintain that such is generally the case in any system of gearing, however long the arc of action may appear on paper. A division of the load on several teeth implies absolute perfection in forming and spacing the teeth, a condition never attained in practice, and it is therefore never safe to assume that the load is carried by more than one tooth under any circumstances. Frequently the service required of gearing necessitates a change in pitch due to wear at some part of the circumference more than at others. For example, in a punching machine the load is concentrated on a few teeth, which do the work while the others have comparatively nothing to do, and as the working teeth wear away there is necessarily a change of pitch between them and the others not so worn, while the pinion probably wears all over and retains a uniform pitch.

By the adoption of a 22½-degree obliquity a considerable increase in the strength of teeth will be effected in addition to the advantages already mentioned, and if it is within the province of the Engineers' Club of Philadelphia to advocate much-needed reforms in engineering practice, I would suggest "Uniformity in Interchangeable Gearing" as a subject worthy of its attention. By the action of the Franklin Institute more than thirty years ago a standard system of screw-threads was inaugurated, and if by the interchange of opinions an agreement among engineers can be reached as to what system of gearing is best for general adoption, the needless diversity which now exists may gradually disappear.

The object of this paper is not to direct an expression of opinion in concurrence with the views here expressed, so much as to bring out well-considered discussion leading to the formation of sound opinions.

I realize that a good deal may be said against the introduction of a new system of gearing differing from those already in use, and that it may be impracticable in many cases to make any change, however desirable, but with the great improvements that have recently been made in the methods of gear cutting a change of system is not so serious a matter as it was a few years ago.

Uniformity in interchangeable gearing by all builders of machinery is certainly to be desired, and to this end it should be possible for engineers to agree upon the system most worthy of adoption, leaving the question of expediency to take care of itself.

Hot Blast Heating.

"In hot blast heating, the proportional heating surface is generally expressed in the number of net cubic feet in the building for each lineal foot of 1-inch steam pipe in the heater. On this basis, in factory practice, with all of the air taken from out of doors, there is generally allowed from 100 to 150 cubic feet of space per foot of pipe, according as exhaust or live steam is used, the term "live steam" being taken in its ordinary sense as indicating steam of about 80 pounds pressure. If practically all of the air is returned from the building, these figures will be raised to about 140 as the minimum, and possibly 200 cubic feet as the maximum, per foot of pipe. Of course, the larger the building in cubic contents the less its wall and roof exposure per foot of cubic space, and consequently the less the loss of heat and the smaller the heater relatively to the cubic contents. In such buildings, used for manufacturing purposes, where the occupants are usually well scattered, an air change once in fifteen to twenty minutes represents the general practice, but in public and similar buildings this change is of necessity reduced to one in seven to twelve minutes. Owing to the increased loss of heat by leakage or ventilation under such conditions, and also to the demand for a slightly higher temperature than in the shop, the allowance is dropped to from 70 or 75 to 225 cubic feet of space per foot of pipe, for all of the air is taken from out of doors and low-pressure steam is usually employed. The great range in all of these figures must make evident the influence of the size, construction and uses of a building upon the size of the apparatus required, and show the necessity of extended experience for the proper designing of any system of heating and ventilation."—Extract from "Treatise on Ventilation and Heating," by B. F. Sturtevant Company.

Don't try to feed a boiler with milk. A branch railroad in the dairy region of New York has a water tank at Cincinnatus which is supplied by a pump in an adjoining creamery. An employee recently made a wrong connection and filled the tank with sour milk and a tender was filled from the tank. The sour milk would not feed into the boiler, and it was found that the connections were choked with curd.

It is stated in England that a machine has been patented for casting steel chains. A single link can be cast on the end of a chain, or it can be made to join two former links together. The links are cast in circular form and are afterwards pressed or forged to elliptical shape, fitted with the usual stud or strut and annealed or subjected to other processes of treatment for steel.

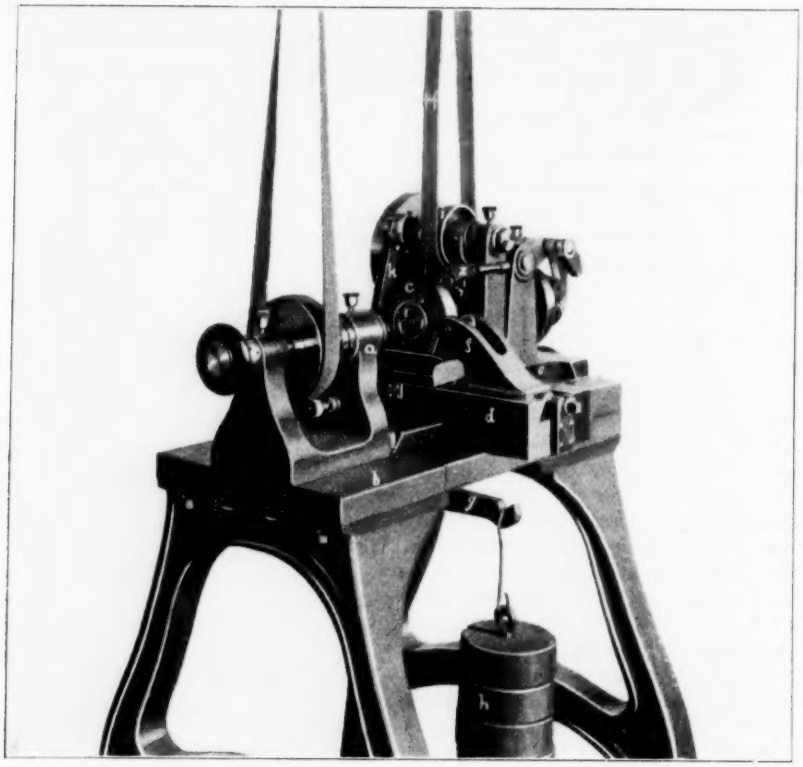


FIG. 1. CAM-CUTTING MACHINE, GENERAL VIEW.

Uniform Feed Cam-Cutting Machine

The accompanying half-tones and line engravings, for which we and our readers are under obligations to the National Cash Register Company, of Dayton, Ohio, show an extremely interesting cam-cutting machine used in the manufacture of cash registers. The class of cam to be cut is the one having a groove of varying radius in the face of a cam disk. It is, of course, desirable that the lineal feed of the cam blank against the milling cutter be constant. In order to accomplish this, the angular feed must be slowed down as the radius of the cam groove increases and be quickened again as the radius reduces, and the special features of this machine are intended to accomplish this object.

The general appearance and construction of the machine is best shown in Figs. 1, 2 and 3. The milling cutter head *a* and the spindle will be seen at one end of the machine, mounted in a fixed position in the base *b*. Facing the milling cutter is the master cam or former *c*, which is also a chuck, being fitted with a draw-in collet for holding the cam blank to be cut. Such a blank with its groove completed is shown in place in Figs. 1 and 3. The base of the machine has lengthwise guideways on which slides a base-block *d*, capable of being slid endways by the lower hand-wheel in the foreground of Fig. 2 in order to present the cam blank to the cutter and sink the latter to the required depth. The base-block carries a laterally sliding block *e*, on which are mounted the head carrying the master cam and feed works. At the right of the master cam in Fig. 1, and rising from the base-block *d*, will be seen a curved arm *f* carrying a roller at its top against which the master cam *c* abuts, being held thereto by a weighted lever *g* and weights *h*. The master cam is revolved by the belt pulley *i* above it; and as it revolves it, together with the entire head, is pushed away from or drawn toward the roller carried by the arm *e* by the action of the cam on the roller and the counter action of the weighted lever. This lateral movement of the master cam is partaken of by the cam blank, and the desired profile of the cam groove is thus produced.

The mechanism for varying the speed of rotation of the master cam and blank to suit the radius at which the cutter is at the moment acting, is made clear in Figs. 4 and 5, in which the parts so far mentioned are given the same letters as in Figs. 1, 2 and 3. The pulley *i* drives an adjustable-stroke crank *j*, which through the link *k* drives the oscillating lever *l* about the center *m*. A second oscillating lever *n* is connected to *l* by a block *o*, which may be slid endwise in a slot in *l*. Lever *n* drives two links *p q*, which in turn drive arms *r s*, which are fitted at their ends with friction pawls properly arranged to drive the flanged disk *t*. Inspection of the friction pawls and of the direction in which they face will show that one pawl drives the disk *t* during the upward movement of *n* and the other during the downward movement. On the shaft of disk *t* is a worm *u* engaging with a worm-wheel below it, but out of sight, except in Fig. 2. This worm is keyed to and gives the rotary feed motion to the master cam arbor. If lever *n* is moved to the right, block *o* will approach the center of motion *m* of lever *l*, and it is obvious that the movement of the pawls, and hence of the entire feed motion, will be reduced, and, contrariwise, that the re-

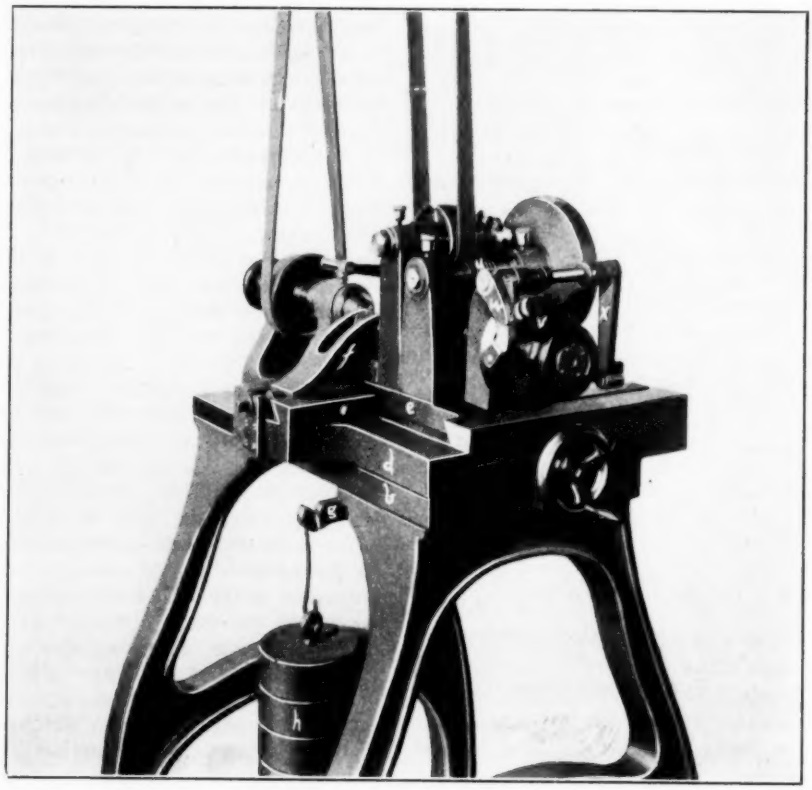


FIG. 2. CAM-CUTTING MACHINE, GENERAL VIEW.

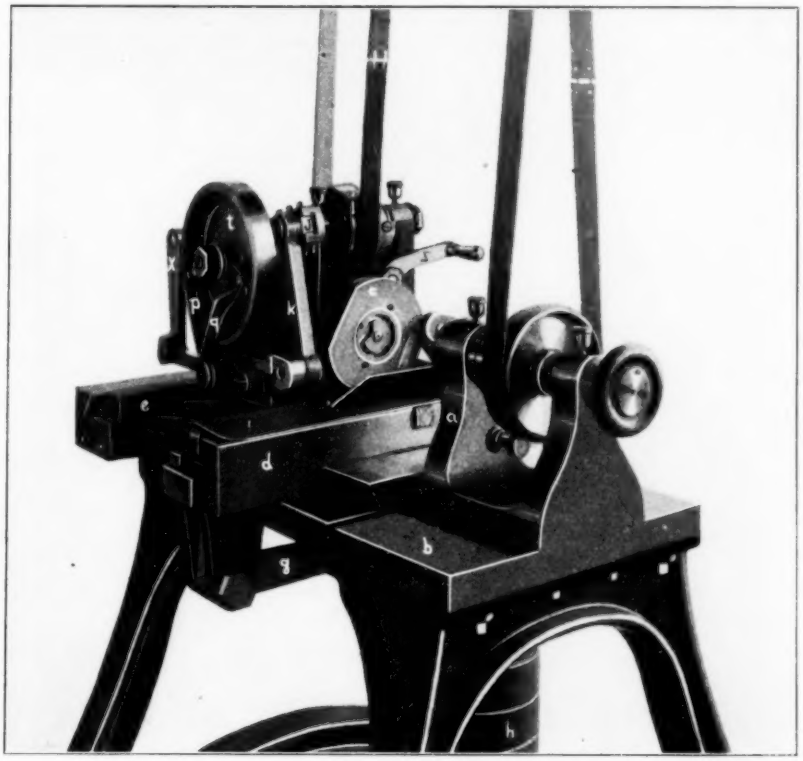


FIG. 3. CAM-CUTTING MACHINE, GENERAL VIEW.

verse movement of *n* and *o* will increase the feed. This adjustment of *n* and *o* is accomplished by the cam *v* mounted on the outer end of the master cam arbor. Cam *v* acts to adjust the position of *n* by the levers *w* and *x* and the rock shaft *y*. A spring on shaft *y* acts to keep the roller at the end of *w* in contact with cam *v*. The profile of cam *v* is, of course, derived from that of the master cam, its hills and valleys being so arranged as to time with those of the master cam, and being of such hight as to give a constant linear feed at the pitch line of the cam being cut.

The stopping and starting of the feed is by the lever *z*. This lever is connected to a clutch on the shaft of driving pulley *i*. The engagement of the clutch to start the machine is by hand, but its disengagement is automatic, being effected by a cam on the master-cam shaft and in the rear of the master cam, where it does not show in any of the views.

The machine has been made of course only for the use of the company named, and it forms an interesting example of the degree of perfection warranted, and in fact called for, in a factory carrying on a large business and aiming to reduce manufacturing costs to the lowest possible figure consistent with good work.

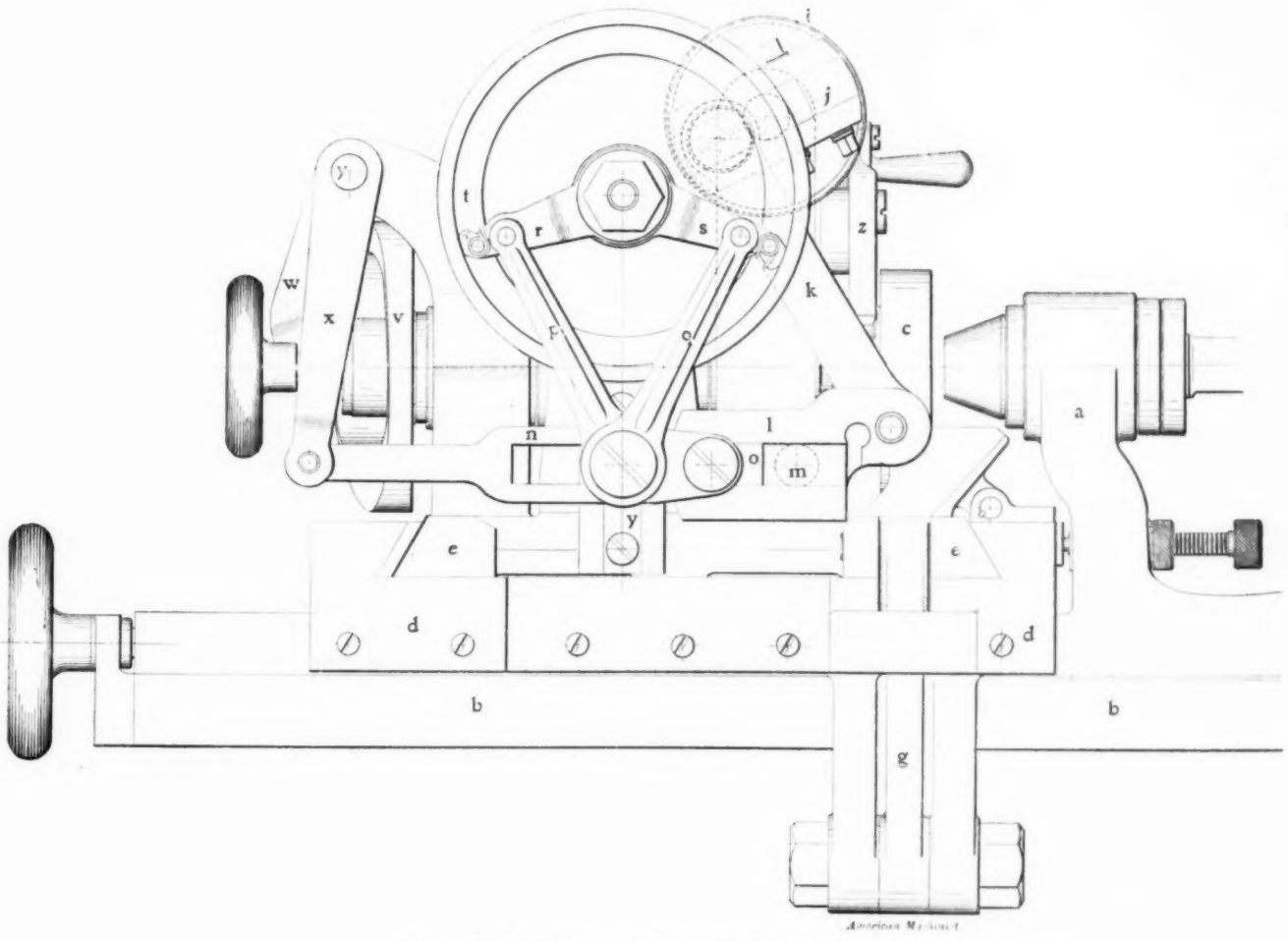


FIG. 4. SIDE ELEVATION OF CAM-CUTTING MACHINE.

Aluminum at the Paris Exposition 1900.*

The five international exhibitions held in Paris, since the first, in 1855, have served as landmarks in the history of aluminum. It made its first public appearance in the shape of a bar, lying on black velvet in a glass case, and labeled "L'argent de l'argile," "the silver from clay." That bar probably cost more than its weight in gold.

The exposition of 1867 found an established industry to be represented. The metal was being sold commercially at the rate of $12 a pound and to the quantity of 1,000 kilograms (1 long ton) a year. The important alloy with copper-aluminum bronze was then shown for the first time.

The 1878 exhibition marked only a moderate expansion of the industry. The yearly output had nearly doubled, but the selling price was the same.

The 1889 exhibition marked a period of revolution in the industry. The yearly output had increased to 71 tons and the selling price of the pure metal had decreased to less than $5 per pound; in fact, that very year it fell to nearly half that figure. The industry was finely represented at that exhibition, as befitted its rapidly increasing importance. The French Deville process, and the two new Castner and Netto processes were large exhibitors, and the Cowles alloy products were shown. The features of this display were the large masses, ingots, sheets, etc., of pure metal, the largest quantity of aluminum ever brought together in one place up to that time.

The last year of the century finds the industry upon an entirely different basis. From an annual production of 70 tons it has risen to the relatively enormous figure of 7,000 tons; from a price nearly $5 a pound to the almost incredible figure of 30 cents. It is almost needless to say that this decrease of price to less than one-tenth of its value in 1889 has been the prime cause of the great demand for the metal. Every decrease in price has opened up the way for larger and novel uses. Many an experimenter has reported of aluminum: "It is most admirably adapted for this purpose, and *when its price shall have been reduced*, etc., etc.," and has waked up a year or so later to the fact that his hoped-for reduction of price had occurred and that the application he had discovered was then possible. The same is true now, as then; possible uses for large quantities of aluminum are now known, which the probable reduction in price during the next five or ten years will convert into actual uses.

Such being the present facts with regard to output, prices and applications, we can state with exactness that the aluminum industry is now, at the end of the century, upon a strictly normal commercial basis. Aluminum is now as really a metal of everyday life as silver, nickel, mercury, copper, brass, tin, zinc, lead or iron, though not to the same degree as several mentioned. In the United States, in 1898, only pig iron, copper, lead and zinc were produced in greater quantity than aluminum, and only pig iron, copper, lead, zinc, silver and gold surpassed it in value of output. When we wish to make a given object in metal, it can be made cheaper in aluminum than in anything else, excepting zinc, lead or iron; brass, copper and all the other metals are dearer.

Bearing these facts in mind, it can read-

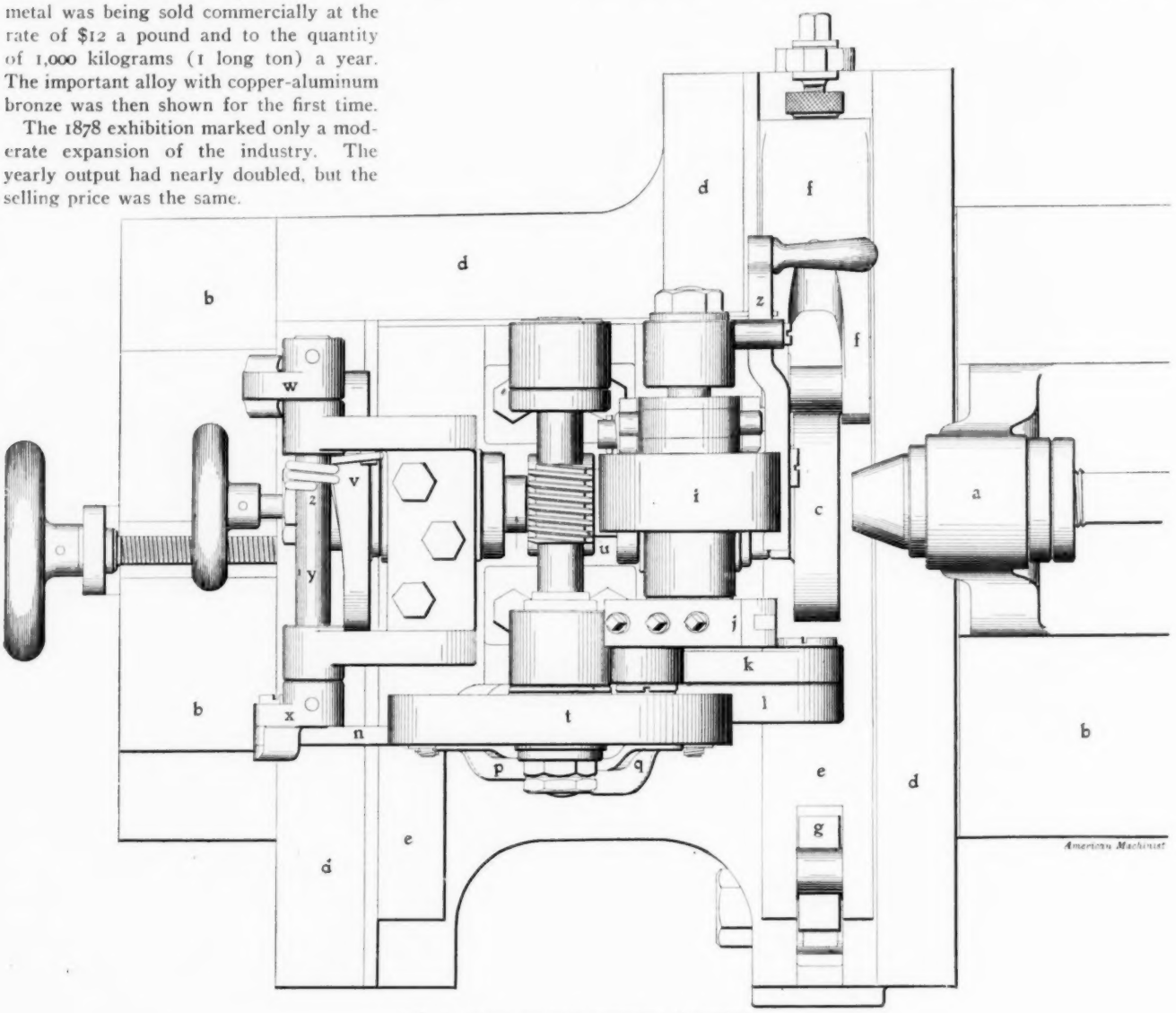


FIG. 5. PLAN OF CAM-CUTTING MACHINE.

*From a paper by Prof. Joseph W. Richards, in Journal of the Franklin Institute.

ily be understood that a complete exposition in one or even in half a dozen exhibits of all the present uses of aluminum was not to be expected. The aluminum exhibit was in reality scattered through all parts of the immense exhibition. In electrical apparatus it was frequently used in place of copper; in the machinery exhibits its use was general in parts of light-running machinery, and frames and cases of auto-vehicles; in optical, photographic and general physical instruments the applications were so general as to defy enumeration; while possibly one-half and probably a still greater proportion of all the steel used in and around the exhibition had had aluminum used in its manufacture to secure soundness of the ingots.

The special exhibits of aluminum represented, therefore, only a fraction of the almost innumerable applications to which aluminum has really attained; and, while mostly satisfactory in themselves, cannot be considered as alone representing fairly or completely the whole industry. By themselves these exhibits were scarcely as pretentious as those of 1889, yet they represented an industry 100 times as large. Taken together with the other applications of aluminum to be seen all over the exhibition, they give an adequate idea of the extent to which aluminum has entered now into daily use.

The firms now producing aluminum are the Pittsburgh Reduction Company, Niagara Falls; the Cowles Electric Smelting and Aluminum Company, Niagara Falls; the British Aluminum Company, at Foyers, Scotland; the Aluminum Industrie Actien Gesellschaft, at Neuhausen, Switzerland; the Société Electrometallurgique Française, at La Praz, Savoy. This year will also see put into operation a new plant of the Pittsburgh Reduction Company on the St. Lawrence River, Canada, and two new plants of the Neuhausen Company, one on the Rhine at Rheinfelden, Germany, the other at Lend-Gastein near Salzburg, in Austria. The establishments already in operation have capacity of 34,000 horse-power, capable of producing 7,000 tons of aluminum a year; with the additions referred to, the totals will be 47,000 horse-power and 10,000 tons annual capacity.

The exhibits in detail were as follows:

The British Aluminum Company, of London, had two large exhibits, the one on the ground floor dealing more with the crude metal, the one on the first floor with manufactured articles. Besides a fine display of sheet, rods and wire, objects of special interest manufactured by various British firms were shown. There was a large still, with hood and condensing apparatus, by Storey & Sons, built for use in distilling acetic acid. Several of these are in use in England, doing satisfactory work. The workmanship was very good. A portable water sterilizer, specially designed for army use, weighing 25 pounds, and capable of producing 200 gallons of good drinking water daily. Some of these have been put to use in South Africa this year. A Derby firm showed a dog-cart with aluminum body and shafts, and spider-like wheels, which was a miracle of lightness combined with adequate strength. Mr. Chatterton, of the Madras Industrial School, sent three large vases and a fine panel, in Indian repoussée style, which were models of fine workmanship and artistic design. The Indian workmen take very quickly to aluminum in place of brass and copper, and the manufacture of culinary utensils for native use is assuming large dimensions. Various other British firms showed hardware, furniture trimmings, ecclesiastical furniture and many other lines of manufactures, all of excellent workmanship.

The Société Electrometallurgique Française, whose works are at La Praz, Savoy, had the next most important exhibit. Besides the usual articles to be expected, were to be seen many novelties. Samples were shown of the military equipments adopted by the French army, some of which had seen severe service in Madagascar. Automobile castings for frames, motor cases and wheels were very much in evidence; also a motor carriage body of sheet metal weighing only 45 kilos. There was a good display of electric cables for power transmission; also various patterns of sleeves for connecting and joining rods and cables. A large funeral wreath of stamped leaves, laurel and oak, painted, recalls a European custom which is unfamiliar here.

Aside from the producers of aluminum, many users of the metal in particular ways were exhibitors. In the line of culinary utensils, the Griswold Manufacturing Company, of Erie, Pa., and the Wagner Manufacturing Company, of Sidney, Ohio, fittingly represented the great interest which Americans take in this most practical application to everyday life. In electrical appliances, many firms in the electrical department showed switchboards, motor frames, motor cases, lamp shades, reflectors, searchlights, etc. In the department of scientific instruments, its use was general for balances, field glasses, telescopes, theodolites, photographic cameras, and parts of many delicate instruments. Mr. Levy, of Philadelphia, used it exclusively in the construction of his apparatus in which he etched plates by his acid-blast process, using dilute nitric acid. Chardonnet's machine for making artificial silk was constructed largely of aluminum for the same reason, since the nitric acid used corrodes almost every other metal which might be used. Escher, Wyss & Co., of Zurich, showed a small aluminum naphtha launch and engine parts. Their work was solid and durable, but lacked finish.

Maxime Corbin, of Paris, showed some remarkably fine large castings for parts of auto-vehicles and motor mechanism. For instance, a dynamo frame complete weighing 185 kilos (407 pounds), a cannon carriage trailer weighing about half as much, for a mountain field piece. His large dynamo pulleys are claimed to be lighter and stronger than wood, and do not slip. This foundry turns out seven tons of castings a month, the larger part of which are for electrical and automobile purposes.

Japy Frères & Co., of Paris, showed a large assortment of army equipments; and E. Legros, of Paris, culinary utensils. Many other small firms displayed miscellaneous articles.

A distinctive feature of the present state of application of aluminum is the development of the hard, strong, light alloys. The Albradium Syndicate, of London, showed one which is a little lighter in color than aluminum, and applied to numerous mechanical uses. The Partinium Company, of Paris, had a large display of their tungsten-hardened alloy in culinary utensils, military equipment and motor cases and frames. The castings were very clean and true, and are of great value if as strong as is claimed—50,000 pounds per square inch tensile strength. The latter claim is probably exaggerated, but it is a fact that the best of these light alloys are as strong as gun bronze, section for section, and work as easily as brass.

The Goldschmidt process of producing many rare metals by ignition of their oxides with aluminum powder was finely represented in the German section. A large case was filled with quantities of pure chromium, tungsten, manganese, and the ferro alloys with these metals, and also with titanium, boron and molybdenum. The collection was unique in its way, and shows the process to be in regular commercial application. A Philadelphia firm has recently made arrangements to work the process in this city.

In the line of working aluminum, the Heraeus process of welding aluminum deserves to be highly spoken of. It is the invention of W. C. Heraeus, of Hanau, Germany, and was represented in the German section by a collection of wires, rods, sheet vessels and urns, with perfectly welded seams. The process is operated without solder or flux of any kind, and consists, according to the inventor, in merely cleaning the surfaces to be joined, laying together, heating carefully to the temperature at which the metal commences to soften, keeping at that temperature and meanwhile hammering together to a perfect weld. The process is thus seen to be that of autogeneous soldering. The inventor lays stress on the fact that the temperature must be kept constant; that if it rises too high the metal becomes short or granular, and also commences to oxidize, which conditions defeat the welding. It is merely a question of maintaining the joint by a blowpipe at the proper temperature of incipient softening and hammering together to a weld. The samples shown were certainly very well done, and the process opens up a new era in the methods of working aluminum.

The Insistent Operative Conditions of the Gas Engines.

BY W. OSBORNE.

While much has been said on the technical side of the gas engine, while its defects as a converter of heat into work have been pointed out and its weaknesses as a machine have been made known, there is one particular of the gas engine, of great interest both to the user and manufacturer, which is not so much discussed; and that is, the man who runs it. There is not an engine on the market to-day that is not blamed at some time for things that belong, not to it, but to the engineer, and yet this trouble, I am sorry to say, does not come from the man directly.

Some builders, in looking for trade, have made extravagant claims. In their desire to show how simple, durable, reliable and easy to manipulate their machine really is, they lead the purchaser to suppose that the cheaper a man will work the more de irable he is as an engineer. Thus it comes about that we sometimes find a man who could hardly run a corn-sheller successfully, in charge of gas engines. This is not said to in any way detract from the merits of the many good men at such work, but to draw attention to one thing that has hindered the more rapid appreciation of the gas engine in some directions.

Another thing that hinders this advancement is the lack of available, practical knowledge of the principles of the gas engine, viewed as a working machine, and from an engineer's standpoint. The knowledge of how to handle steam engines is nearly universal in this country. The boy on the farm has seen the threshing engine and heard engine talk ever since he can remember. Every sawmill and grist mill has been an educational center for its community of boys and men. The locomotives, running through the country in all directions, have carried the fever, so that a great many boys have been studying and planning for the time when they could have an opportunity to run one. These things have been going on ever since the steam engine became familiar as a power producer, and now it is hard to find a community where there is not someone who understands the conditions necessary to have an engine run; not always under the best conditions for efficiency, perhaps, but still run and do its work.

Furthermore, while I consider that the gas engine, as a machine, is far simpler and easier to manage than a steam engine (including the boiler), there is one thing that should be distinctly borne in mind, and that is, that while the conditions under which a gas engine will run are thus simpler, they are also more imperative.

To explain my meaning by an illustration: To start a steam engine, the boiler must have its proper supply of water, the fire must be built, steam raised, the engine crank must be put in proper position, the cylinder cocks opened and the steam turned on. The last act does not call for any nicety of manipulation. More or less steam, so that there is enough to start, only means faster or slower motion, and not a failure of the whole attempt. With a gas engine (I am speaking in both cases of the small sizes of engines that are commonly found all over the country), if it uses a tube ignition, the gas is lighted to heat it, the engine is set in position to draw in its first charge, the valve or valves are opened to admit the charge, the motions necessary to draw in and then to fire the charge are gone through, and the engine starts. To have the engine start, though, requires close attention to some apparently simple things.

The tube must be hot enough. The engine must be set right to have the functions come in their proper order. The right amount of gas and of air must be turned on, and a certain amount of energy must be imparted to the wheels. A failure in any one of these means a failure to start.

Any man that is doing work on the road in the gas-engine business—it matters not for what make or style of engine he is traveling—will tell you that much oftener, in case of trouble, it will be found to be due to non-compliance with one of these conditions, rather than to any defect in the engine. He will also likely tell you the third particular is the one that most frequently gives trouble; that is, not getting the gas and air turned on in the proper proportions; and nearly always the gas is in excess. The reason for this is not far to seek. With steam, "the more steam the more work," therefore with a gas engine, "the more gas the more work," instead of "the more mixture, the more work," which is true of a proper mixture.

I believe I am safe in saying that a lack of proper understanding of this one point has given more trouble to gas engine users than all other causes combined, except actual neglect.

It cannot be too constantly borne in mind that gas engines, so called, are gas and air engines, and that the air is just as essential to their operation as the gas; and also that more gas does not mean more power, but often much less. Air is cheaper than gas and it pays to use all of it that the gas needs; better have a surplus of air than a surplus of gas, better for the engine and better for the pocket-book. If a man gets the idea firmly fixed in his mind that, to run a gas engine, he must get the charge in, keep it in and explode it, and that the charge must be of a proper proportion, he need have very little trouble, outside of actual breakage, in running an engine.

Some judgment in setting is necessary to get the mixture right, and if a man does not clearly understand why he is trying, it is not as readily done as if he does. Gas, being always under some pressure, comes in whenever a valve is opened, the air only when there is some diminution of pressure within. The slower an engine is turned the less gas should be turned on, as it has more time to get in and crowd out air. The lighter the atmosphere the less gas should be turned on, as it has less pressure to help it in getting in; and, more important still is it to remember that if not enough gas is turned on, repeatedly trying to start tends to correct this, and finally enough will be gotten in; but if too much is turned on, increasing effort only makes the matter worse, and the engine cannot start until this surplus gas is gotten rid of. This can be easily done by shutting off the gas and turning the engine as in starting, thus pumping out the surplus gas. Caution should be used, as when enough has been gotten out, the charge will explode. When this happens the engine is ready to make a fresh start.

I once visited a plant driven by a gas engine, and found four pressure regulators between the main line and the engine, and at the engine a cock carefully marked, as well as means for adjusting the air opening. This showed how important they considered a regular pressure.

Anyone that can do a little thinking, that can keep his eyes open, and who is careful, can run a gas engine. In the hands of a careless man it is safer to have in a neighborhood than a steam boiler is, but it will refuse to run, for trifles that a steam engine wouldn't mind, and to run its best it must be humored in its peculiarities. "Like causes producing like effects," it is clear proof that the causes are not alike if the effects are different.

I have not gone over in detail the other peculiarities, as I believe that the man that thoroughly masters this one is intelligent enough to handle the rest; while if he does not master this one, he will have so much trouble that a little more will not matter much.

A standard system of tapers for twist-drill shanks, mandrels and the like has been proposed to the Union of German Engineers at Breslau by Herr Pasler. It embraces eleven sizes ranging from 9 m/m diameter of shank at the small end and 12.5 m/m at the large end to 80 m/m at the small and 100 at the large. The system is made as simple as possible, and also is accommodated to the Morse system in order that drills of the latter may be used in sockets of the new system as far as possible, either with no alteration or with but a slight one. A taper of 1-20 is followed throughout. The larger tapers are decimally arranged and correspond to Reinecker's.

Hardness, or the Workability of Metals.*

BY W. J. KEEP.

A test of the workability of a metal will not distinguish between hardness, which blunts a tool, and tenacity, which makes it difficult for a tool to remove a portion of the material.

A punch pressed into the surface of a metal is hindered by both these properties.

Prof. Thomas Turner constructed a machine which indicated hardness by the scratch of a standard octahedral diamond across a polished surface. Gram weights were placed on the diamond until a scratch could just be seen as a dark line on a bright surface. The number of grams was the degree of hardness. This is the most practical test for metals too hard to be cut with a drill, such as chilled and white cast iron.

In the Transactions of this society, Vol. v, page 140, Prof. Thos. Egleston described a machine for testing hardness by the use of a weighted drill, which he afterwards abandoned.

In 1897 Mr. Chas. A. Bauer, unaware of any former experiments along this line, arranged an ordinary drill press as a test of hardness. He used a hand-made flat 3/8-inch drill, with 160 pounds pressure, with a speed of 250 revolutions per minute.

A revolution counter records the number of revolutions of the drill required to penetrate a test bar exactly 1/2 inch after the lips are under the surface. This apparatus has been in constant use since that date, and is a practical success.

[A full account of the Bauer machine, with illustrations, appeared in our issue of April 1, 1897, so that it is not necessary to reproduce a view of the machine here. Incidentally, it may also be proper to mention that a full account of the hardness testing apparatus of Ludw. Loewe & Co., Berlin, is contained in the editorial correspondence of this paper in issue No. 36, 1900.—Ed. "American Machinist."]

I arranged with Mr. Bauer to make such machines for the market, using an autographic diagram for a record instead of the number of revolutions. When I had constructed a machine, I found that with an ordinary drill press the varying friction of the working parts influenced the diagram. With a drill penetrating the top of a test bar, the hot chips remaining in contact with the drill drew the temper of the extreme edge. A horizontal machine developed more defects than the vertical form. After repeated failures, I placed all of the working parts below the table, making the drill enter the under side of the test specimen, and not giving the drill any vertical motion.

Fig. 1 shows this machine. A table, with a vertical motion, has the test bar clamped on its upper surface over a 1/2-inch central opening, which receives the point of the drill. Four rods attached to this table pass downward, and are attached to an iron weight near the floor. Loose weights, from 1/2 pound to 10 pounds—50 pounds in all—are added, making the whole load on the drill point 150 pounds. The test specimen is weighed, and an equal amount of removable weight is taken off. The downward movement of the specimen is transferred by a steel ribbon to an arm moving on ball bearings, the end of which carries a recording pencil, which multiplies the record five times. To allow this pencil to act directly on the paper, a table is provided, with a curvature equal to the path of the pencil, and which is moved at right angles to the mark made by the pencil by means of a screw driven by a worm on the drill spindle; 100 revolutions of the drill move the paper 1 inch; 1/5-inch penetration moves the pencil 1 inch.

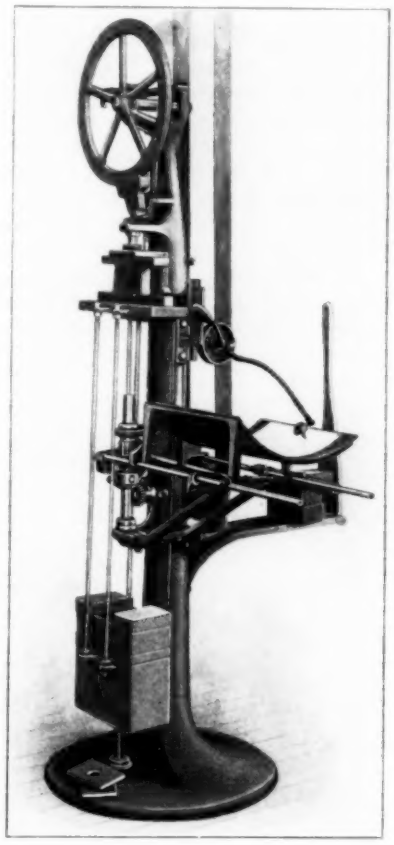


FIG. 1. KEEP'S HARDNESS TESTING MACHINE.

[The following additional description of the apparatus, not a part of the paper is kindly supplied by the author.—Ed.]

"All that hangs on the point of the drill, composed of the test bar with the wooden block and wedges by which it is clamped to the table, with its rods and weights, weighs 150 pounds. Just under the table is a tray to catch all drillings. The drill point passes through the tray and table to the test bar. Between the table and the tray is a revolving disk, packed with rubber to prevent dust following the flutes of the drill. The disk revolving with the drill catches all drillings and throws them to the edges of the tray, which fits dust-tight to the table, saving all for analysis. The table casting extends upward behind the test piece, and then forward to allow the clamping of the test pin to the table. In the center of this upper part is keyed a round guide which slides freely through a bushing in a projecting part of the frame. The shaft of the hand-wheel above it has teeth cut in its surface and a rack shown balanced in a horizontal position across it. When this rack is brought to a perpendicular position a pin on its lower end is passed through a hole in the upper guide of the table. Friction is applied to the hand-wheel to sustain the 150 pounds. When the hand-wheel is moved the test piece moves with it. When the test bar is lowered to rest on the drill point the rack is detached and placed in the horizontal position shown. The vertical strip at the right of the table is connected to the disk directly behind it by two steel ribbons, which change any vertical motion of the table into rotary motion. The counterbalance arm on ball bearings, having a pencil at its lower end, is held to the disk by a set-screw. Before tightening a base line is drawn parallel with edge of the record paper. The belt drives a loose pulley on the rear end of the arbor which carries the beveled gear. In the rear end is a socket for a 1/2-inch flat drill ground left handed. A test bar can be placed on the blocks shown on the shelf and pressed against this drill by the vertical lever to remove scale and sand at the point which is to rest on the test drill. By raising a lever at the right of the gears a clutch causes the test drill to revolve, and sets a trip, which, when the drill has penetrated the required distance, throws the clutch out. Each ten revolutions of the drill turns a horizontal screw one revolution. This screw has ten threads to an inch and moves the record holder on the horizontal guide rods. The pencil moved by the table at right angles to the motion of the paper describes a diagonal. Any variation in hardness requiring more or less revolutions of the drill, changes the direction of the diagram. To prevent any horizontal vibration of the hanging load a post projects from the base. Ball bearings around a hole in the weight prevent friction."

Scale of Hardness.—As the diagram will be a diagonal between 90 degrees and the base line described by the pencil before the drill moves, with an ordinary transparent protractor, the angle that the diagram makes with the base line is the degree of hardness, 90 degrees, the limit of the machine is the hardness of any material that the drill cannot penetrate.

The speed of the drill is 200 revolutions per minute, to prevent heating under all

*Presented at the New York meeting (December, 1900) of the American Society of Mechanical Engineers.

conditions. A variation of speed does not materially vary the diagram.

The specimen and its weight hang on the point of the drill practically without friction. They move so freely that it is necessary to apply a slight friction to the ball-bearing to prevent a vibration of the pencil point.

A variation of load would materially influence the diagram. 100 pounds gave 45 degrees; 125 pounds, 38.4 degrees, and 150 pounds, 32.9 degrees. A trip is set to stop the drill at any desired depth of hole.

TABLE I.

Number revolutions of drill	100	200	300	400
First test.....	45.1 degrees	44.6 degrees	43.9 degrees	43. degrees
Second test.....	29.1 "	30. "	29. "	28.6 "
Third test.....	27.9 "	27. "	28.4 "	—

The machine is started by a clutch. By a pinion and rack, that is disconnected while drilling, the table with specimen is raised or lowered at will by a hand-wheel at the upper part of the machine, with friction applied to its rim, that will support the 150-pound load.

Drills.—I found that a straight, fluted drill made a better diagram than a twist drill, and would wear better. The Cleveland Twist Drill Company guarantees to make drills for this purpose of uniform temper and shape. I grind the heel of the drill away, so as to leave the lips 1-16 inch thick and the shape of an ordinary flat drill. The straightway drill gave 25 degrees, and the twist drill 29 degrees, but probably the difference in clearance would cause this. The straightway drill ground to 10 degrees gave 77 degrees; given a very little clearance, but the heel still touching, gave 59 degrees; with heel ground away like a flat drill gave 30 degrees.

Grinding.—I found that a dry wheel would draw the temper from the extreme cutting edge, and that the ordinary grinders would not make each lip cut alike. I therefore made the very simple wet grinder shown in Fig. 2. The angles of the drill are those recommended by the drill-makers, and in using the machine all drills are to be ground on this grinder. The grinding does not, however, make very much difference. Drill sharpened by grinder, all angles exactly alike, and both lips taking the same chip, gave 30 degrees; drill sharpened by hand, 31 degrees, and ground so that only one lip cut, gave 30.8 degrees.

Entering the Drill.—If the drill is started on a flat surface it enters more rapidly at first, making the first part of the diagram a curve, showing the hardness of the skin of the casting, or else the influence of the scale on the lips of the drill. The test bar may be pickled to remove the scale, but in any case the cutting edges will be blunted by the grit in the surface. Entering through the ordinary sand scale of a 1-inch square cast-iron test bar, the drill gave a diagram clear through the bar of 39 degrees; but the same drill resharpened, and in a hole alongside with the scale ground off, gave 32.5 degrees. I, therefore, countersink with a ½-inch drill until the lips are nearly into the surface. Entering, the test drill in this countersink begins with a full cut, and shows the hardness of the metal uninfluenced by local and varying conditions. (I use the term "hardness" when I mean workability of the metal, or abrasive resistance.) For experimental work, as for this paper, the drill is ground after drilling each hole; but if the surface is first removed, for shop use this is not necessary. The following records were made by drilling holes in the same bar in succession ½ inch deep without resharpening; the surface was ground clean: 25.6, 25.5, 25.8, 26.5, 25, 25, 26.8, 26, 27, 27.5, 26.9, 27, 27, 27.2, 27, 26.3, 26.8, 25.6, 27, 25.5 degrees, the last being the same as the first. The same bar, with the drill sharpened after each hole, gave 27.6, 26.5, 26.2, 25.5, 26.2, 26.5 degrees. In another bar of another iron, sharpening each time, holes near together, gave 28.5, 28.2, 30.8 degrees. Spongy spots in castings, though called sand holes, usually do not contain grit, and do not injure the drill; as soon as sound metal is again reached the original diagram is resumed.

Fig. 3 shows such a diagram from a bar ½ inch square, and another diagram from a hole alongside, where the metal was all sound. The first diagram is from a bar containing hard spots and soft spots. The drill strikes a hard spot that it cannot cut, even after regrinding. When the metal is nearly too hard to cut the edge becomes dulled. In a sample of almost white iron the drill penetrated 3-10 inch at 61 degrees, then 90 degrees, resharpened and in the same hole ⅕ inch at 61.5 degrees, then 90 degrees; sharpened again 1-25 inch at 82 degrees, then 90 degrees; again sharpened ⅖ inch at 62.8 degrees, then 90 degrees.

In a test bar of series 1, Iroquois, ½ inch square (the first diagram in Fig. 3 is another hole in this bar), near the ends there were no hard spots, but near the center the fracture was full of white spots. The drill entered 58.5 degrees; at 1-20 inch deep struck a hard spot, about 1-40 inch thick, 84 degrees; then for ⅕ inch soft, 49.1 degrees; then hard, 65 degrees. Another hole alongside, 1-10 inch deep, at 51 degrees, then 90 degrees, resharpened and in same hole 63 degrees, then 74 degrees, then 82 degrees, then a soft spot, 64 degrees; then 75.2 degrees, then 90 degrees, resharpened and 90 degrees, would not penetrate farther, and hole only ⅗ inch deep. A soft metal, on account of its toughness, will sometimes give a larger record than a harder metal. A test bar from tea-chest lead gave 4 degrees, because the metal was simply crowded into the flutes of the drill; but block tin gave clean chips and was 1.1 degrees with 150 pounds on the drill, and 2 degrees with 100 pounds. An alloy of 90 parts aluminum and 10 parts tin gave 10.5 degrees with 150 pounds, and 16 degrees with 100 pounds. A test bar of soft copper gave 47 degrees, while a bronze, with 90 per cent. copper and 10 per cent. aluminum, gave 21 degrees; and a bronze with 9 per cent. aluminum gave 23.8 degrees, though it was softer than the 10 per cent. metal. The copper was soft but tough. A bar of Jessups steel gave nearly the same diagram as purchased and after annealing in lime.

A rolled bar of puddled iron gave 63 degrees; a cast bar of Bessemer steel (with no manganese), 73 degrees; a bar from grain nickel, 77 degrees.

Three sets of ½-inch square test bars were made at three different times—one

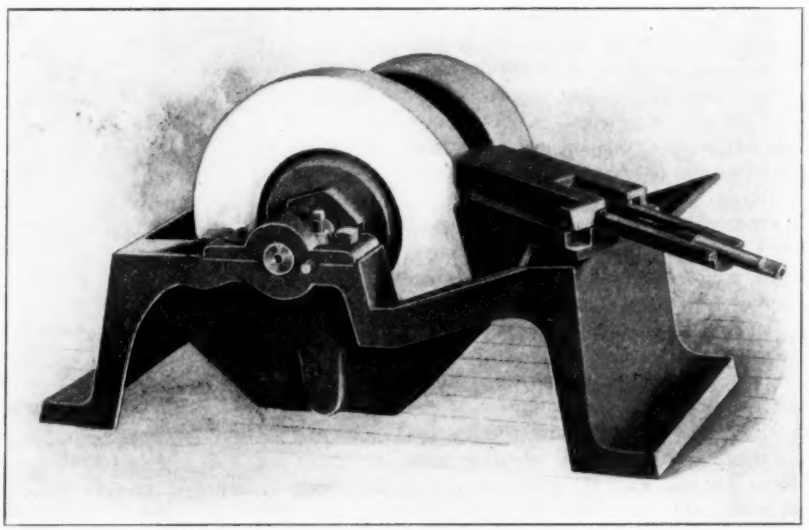


FIG. 2. KEEP'S WET DRILL GRINDER.

bar in dry-sand molds; one bar in sand as ordinarily moistened for green-sand molding, and the third bar in sand so wet that water would run out.

TABLE II.

	First set	Second set	Third set
Dry sand.....	25 degrees	28 degrees	29.5 degrees
Ordinary sand.....	26 "	30 "	29 "
Very wet sand.....	29 "	29 "	33 "

Drillings for Chemical Analysis.—This machine is especially made for this purpose. A tray slides under the table, and the drill passes through a revolving disk between the tray and the under side of the table, having a rubber packing around the drill. Around the hole on the upper surface of the table is a gutter to catch any dirt or sand, and the raised edge around the hole makes a close joint with the test bar, the under surface of which is free from sand on account of the countersink.

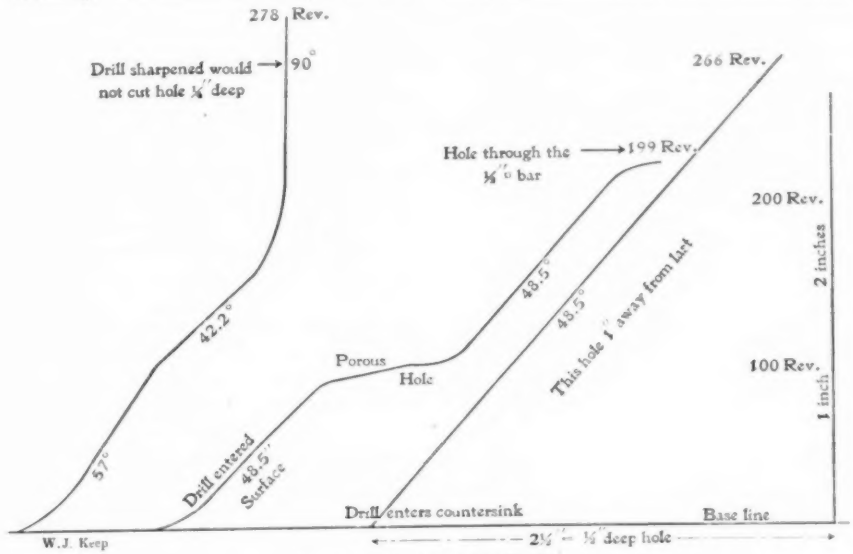


FIG. 3. HARDNESS DIAGRAM.

The disk revolving with the drill catches all the drillings and throws them to the sides of the tray, mixing them thoroughly, and all particles of dust are saved. The tray fits dust-tight under the table. When these drillings are placed in a marked envelope they are free from all outside matter and should be used as a whole and no parts selected with a magnet. Chemical analysis would interpret the hardness diagrams. Everything about the machine being practically invariable, except the hardness of the test piece, the size of the drillings will vary with the hardness, and therefore there will be a standard of uniformity that is most desirable. For laboratories not having power the machine is driven by hand.

Hardness and Chemical Composition.—According to general opinion all of the chemical elements found in cast iron harden it. Carbon and manganese certainly do. Sulphur causes the carbon to be combined and thus hardens. Phosphorus does not influence carbon, but hardens. Silicon hardens cast iron, but it causes carbon to change from the combined state into graphite and thus becomes a softener. A white iron that cannot be cut, by an addition of silicon becomes mottled or gray and can be cut. Hard iron softened by changing combined carbon, becomes tough as it becomes soft, and in a test of workability this modifies the record which otherwise might show the influence of chemical composition.

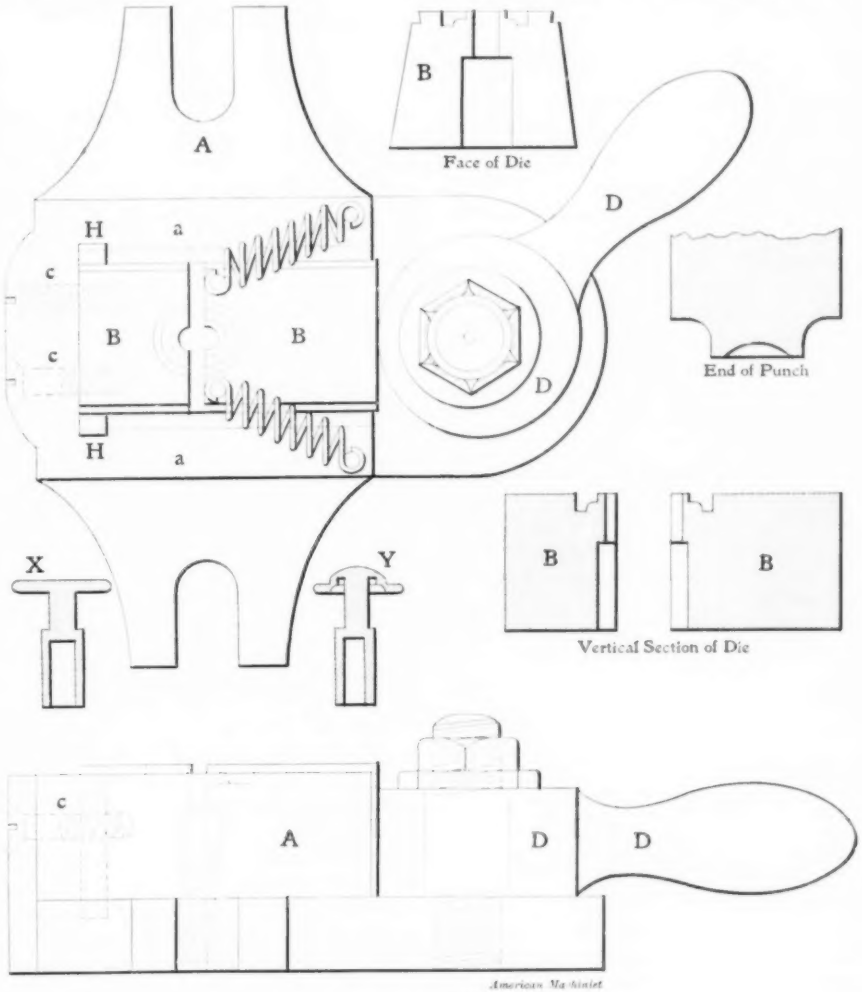
[The latter portion of the paper comprises records and tables of tests, which our space will not permit us to publish. Those interested may find them in the Transactions of the American Society of Mechanical Engineers.—Ed.]

A Special Forming Die.

BY JOSEPH V. WOODWORTH.

In the sketch is seen a somewhat special die for forming the head of the piece shown "before" and "after" at *X* and *Y*. The piece *X* was made in the screw machine from round brass rod, with a neck smaller than the body, and as it was impossible to form it in a solid die, the laterally opening and closing die here shown was made.

The base of the bolster *A* is ½ inch thick, and the central portion *a* is 1 inch thicker, this portion being planed dovetailing for the die to fit slide in. The casting has openings provided at *H H* for the tool to run into in planing the dovetail, the shape of which is seen in the view given of the vertical face of the die. The two halves of the die are planed together in a single piece and, after fitting into the



A SPECIAL FORMING DIE.

FIG. 1. A UNIVERSAL CLAMP DRILL.

bolster, are planed apart, and one half of the die is fastened securely back by the flat-head screws *C C*. The other half of the die slides, being forcibly closed by the handled eccentric *D*, and pulled open by the springs on each side. When the dies are properly fitted and closed tight the bolster is clamped to the face-plate of a lathe, the hole for the neck of the piece is drilled, the shape for the under side of the head is worked out by hand tools and all nicely polished. The larger straight part of the hole is counterbored from the under side. The depth of the smaller hole of the die, which clasps the neck of the piece to be formed, must be less than the length of the neck, to permit the head of the piece to rise out of the annular molding before the lateral movement of the half die in opening occurs. A hole is drilled in the bottom of the bolster concentric with the finished hole in the die, and a pin is driven in with a loosely fitting spring around it to serve as a knock-out or lifter for the finished pieces. A section of the end of the punch is shown, the finishing of which was a job of simple lathe work, requiring no special mention.

A Universal Clamp Drill.

The half-tone, Fig. 1, shows a handy clamp drill which, according to machine-tool usage, may be styled universal by reason of its complete command of possible drilling positions. With the aid of Fig. 2, which shows the principal working parts of the drill, little explanation is required. The drill-post is clamped as may be most convenient, and then the drill is adjusted on the post in any position required. Besides the several adjustments by which the drill and drill spindle are set, the crank may be moved around the frame to different angles, as may be most convenient for the operator. The knurled nut *C* is slacked, and then the hub of the bracket which carries the crank shaft is lifted away from the main frame enough to permit it to be shifted around, when it may be clamped again by tightening the nut. A little pin on the face of the hub of the crank bracket has a series of holes provided for it as close together as possible on the face of the hub of the frame, and when the bracket is turned around the pin drops into another hole. The drill spindle *D* has a long thread which runs up through the revolving bronze gear *I*, which is the feed nut of the drill. While this feed nut turns with the drill spindle, its speed of rotation is not precisely the same as that of the spindle. The gear *H* is splined to turn with the spindle. This has 25 teeth and meshes into *G* with 24 teeth. On the same sleeve with *G* is gear *F* with 19 teeth meshing into *I* with 20 teeth. Therefore for 96 rotations of gear *H* with the spindle, the gear or nut *I* makes only 95 turns, or, relatively to the spindle, it turns backward one turn, and as the pitch of the thread of the spindle is 6 to the inch, the feed of the drill is $96 \times 6 = 576$ to the inch. By pulling the knob *A* the sleeve carrying the two gears *G* and *F* is slid endwise, throwing *G* and *H* out of contact, but at the same time *F* is locked from turning by one of the tooth spaces of *G* dropping over the projecting pin *x* in the frame. This, of course, also locks *I*, and when the spindle is rotated it moves up or down in the nut at its full pitch of 6 to the inch. This constitutes a quick return, and is also used for bringing the

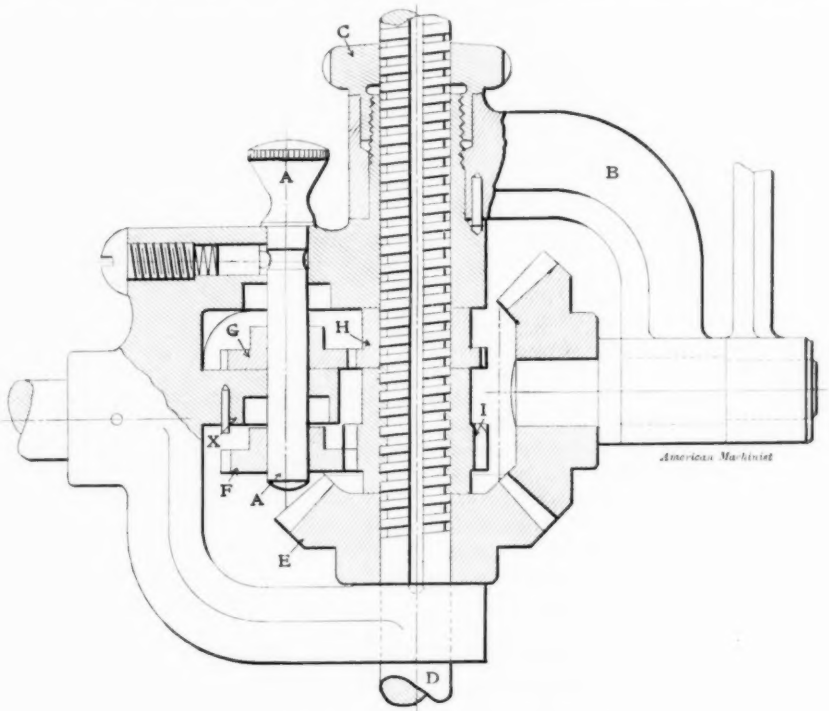


FIG. 2. DETAIL OF UNIVERSAL CLAMP DRILL.

point of the drill to engage the work at the beginning of the drilling. This drill is made by the Jackson Patent Shell Roll Company, Pawtucket, R. I.

Letters from Practical Men

Unfair Conditions Regarding Foreign Patents.

Editor American Machinist:

The article on "Trade Marks in Germany," printed in your No. 52 last year, closes with an expression of hope on the part of the "Tageblatt" that the projected German-American treaty may provide better mutual protection for patents and trade marks.

While the question of trade-marks has been repeatedly ventilated, I think the protection of American patents in Germany has not been sufficiently agitated by the industrial press. As you are aware, in taking out an American patent the German has practically the same protection as the American, while patents taken out by Americans in Germany and in some of the other continental countries, become practically worthless unless the article is being actually manufactured in the Empire within two or three years from the issue of the patent. The recent decisions of German courts have shown that it does not suffice to manufacture only a small percentage of the quantity sold in the empire, but that it is imperative to actually produce in Germany about 75 per cent. of goods sold.

I fully recognize that patents do not give absolute protection against competition, and that they can often be evaded; nevertheless, they serve in the United States as well as in Europe to greatly reduce the chances of an article being copied, for every honorable manufacturer, and even one inclined to be less scrupulous, will hesitate to copy a design if he sees even the possibility of a legal conflict. Standard machines, as lathes, planers, etc., do of course not suffer so much from the inequality of the respective laws as the many ingenious designs in automatic and special machines; the latter class embodies frequently not only the results of many years of experience, but often also represents the expenditure of an untold amount of capital, and therefore can be sold by the copyist much cheaper than by the originator. I believe many of our most prominent manufacturers have had sad experience in this line, being obliged to sell either at a reduced price on the continent of Europe or to leave that section of the world to those that take advantage of the present continental patent laws.

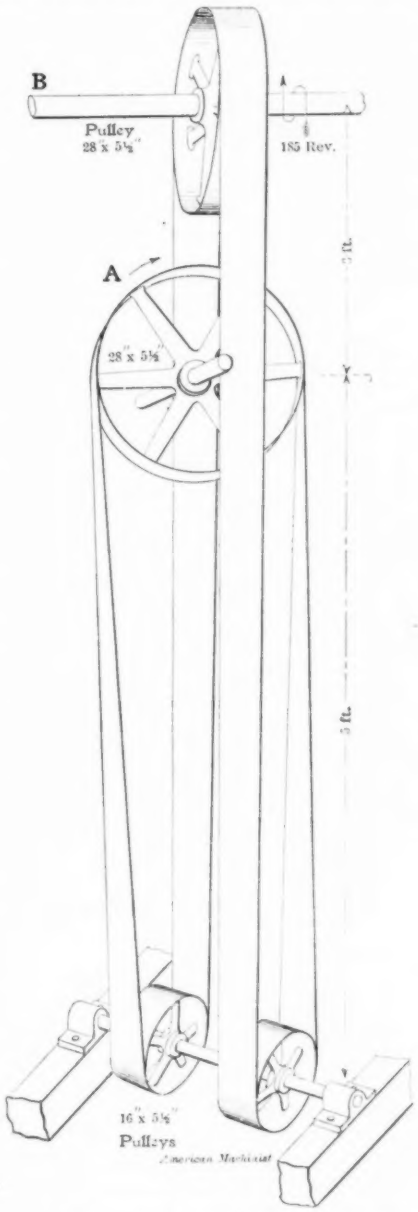
If the United States shaped their patent laws on continental principles, Americans would of course have no cause to complain, but why should the prevailing unequal conditions continue to exist? The present revision of treaties certainly offers an excellent opportunity for putting an end to this source of unfair competition.

Berlin. F. G. K.

A Quarter-Twist Vertical Belt Driver

Editor American Machinist:

The accompanying sketch illustrates what I believe to be a new method of driving shafts at right angles to each other, not in the same plane. This drive was designed by W. P. Sisson, superintendent for H. W. Caldwell & Son Company, and installed in their shops at Chicago a few weeks ago. It operated successfully from the start.



A RIGHT-ANGLE VERTICAL BELT DRIVE.

The problem presented was to drive the countershaft *B* from the line shaft *A*. This could have been accomplished by a mule-stand drive, preferably, in our opinion, by Manilla rope; but, even under the best conditions, such a drive is to be avoided if possible, owing to the difficulty experienced in preventing the ropes or belt from running off the mule pulleys, if for any reason the motion of the transmission is reversed. An ordinary quarter-twist belt was out of the question on account of the short distance between centers (3 feet). Mr. Sisson was equal to the emergency, and, discarding old ideas and methods, designed the drive herein illustrated. The direction of motion is shown by the arrows, but it can be reversed without affecting the operation or efficiency. Although the idler pulleys revolve in the same direction, one is setscrewed to the idler shaft and the other runs loose, to prevent any undue slippage of the belt, in case the two pulleys are not exactly the same diameter. Please note the small space occupied by the transmission. There is ample clearance between shaft *A* and the belt.

ROBERT J. PEARSE.

A Lubricant Used in Re-Drawing Cylindrical Shells.

Editor American Machinist:

A little time ago I received a personal inquiry from the National Armory at Springfield, Mass., as to what we were using in the large brass-manufacturing establishments of Waterbury, Conn., for lubricating cylindrical shells in their successive re-drawing-, and I gladly sent them the following recipe, which, I have been informed since, has proved as successful with them as with us; so I send it to you, as it may be of value to others in the press working of sheet metals. The recipe is as follows: 12 pounds green olive soap, 2 pounds tallow. Each should be cut up into thin slices and put into a sheet-iron tank made for this purpose. This tank ought to be 2 feet high and 2 feet square. The two ingredients must be thoroughly boiled together in the above-named tank, and should afterwards stand at least three or four hours, after which it may be thinned to suit one's judgment.

We have a steam pipe and valve connected with this tank, so as to warm up the lubricant when we are about to use it. The temperature of the lubricant when in use should be about 130 degrees Fahr. Let us assume that the shells have been cut and drawn on a double-acting power press, then carefully annealed, pickled and washed. Now we are ready to proceed to the operation of re-drawing. The pressman opens the steam valve connected with the tank, and warms the lubricant, after which he puts a quantity of the annealed shells into a wire basket and immerses them in the tank.

We usually have, to hold the shells, a receptacle attached to the die bed in front of the press, and the man running the press takes the shells from the wire basket and puts them into this in quantities easy for him to handle. We have used this lubricant very successfully in the re-drawing of shells or tubes used for bicycle foot-pumps, and they are 12 inches long and 1 inch in diameter.

We use good lard oil for a lubricant in the first, or cutting and drawing opera-

tions, on our double-acting cam presses, it being understood that our first shells or cups are made directly from the sheet-stock, with tools as described and illustrated in the "American Machinist," November 23, 1899. We also use good lard oil for a lubricant in using compound dies connected with the sub-press.

C. C. CANDRIAN.

Waterbury, Conn.

Making Thin Castings.

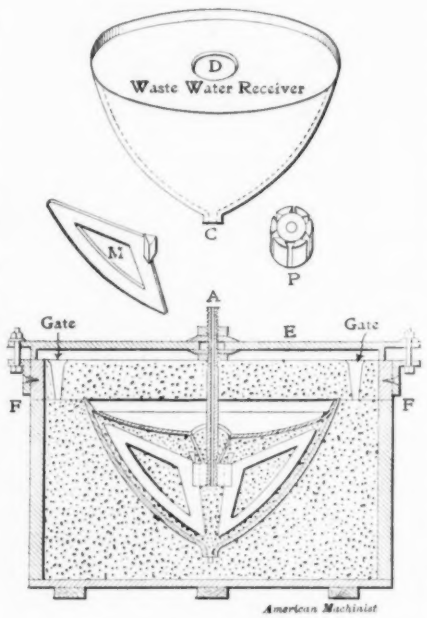
Editor American Machinist:

Where thin castings are required, usually classed as hollow ware, the question with the foundryman is as to the most economical way, all things considered, for molding the work, especially whether it shall be with green or dry sand cores, the determination depending upon the number required, thickness of metal, etc. With such castings as soil pipe, tea kettles and hollow ware generally, it would be very difficult, if not practically impossible, to maintain a uniform thickness of metal if dry sand cores were used, and so expensive as to virtually prohibit their manufacture. Hence the foundryman's ingenuity is frequently severely taxed to invent some collapsing arbor or anchor that will serve as backbone and ribs, either of wood or iron, whereon the fragile green sand core will securely cling sufficiently firm to withstand the heat and pressure of the liquid iron and yet be soft and porous enough to absorb the generated steam and gases, or permit of this exit to and through the avenues provided by the molds.

The sketch herewith is to show a casting of this character. This is a waste-water receiver once used in considerable numbers, if not now, upon passenger cars. The idea was to prevent the waste water from dripping when detained in a station, a valve, located at *C* in the drain pipe, being closed or opened as occasion required. This reservoir had but a small opening in its flat top, as shown at *D*, some 4½ inches diameter and a small hole in the bottom at *C*.

The arbor or anchor to carry the green sand core has six wings, each as per *M*, the little dovetails of which are fitted loosely into the female dovetails of the hub *P*. By driving in wooden wedges the wings were securely held in position. A piece of gas pipe threaded at each end, as shown at *A*, and screwed firmly into the hub *P* completed the skeleton and mounting for the core. The plate or top part of the pattern was necessarily removable, thus giving opportunity to insert the arbor and properly ram the core.

The operation of molding was to first put the nowel and pattern upside down upon a mold board, ram up, turn the nowel over, remove the follow board and then with evenly low-tempered (dryish) sand proceed to lay up a thickness, say, 1½ or 2 inches thick all around the inside of the pattern. Put thin clay wash upon the anchor and not too much of it, then insert the anchor, work it down firmly into place and tuck it up with the fingers. The core does not need to be and cannot be made hard, as it absorbs a great deal of moisture from the arbor and the hand tucking will be amply hard enough. When rammed up properly, put on the top of the pattern and ram the cope. It is well to have something around the screw as a shield. A larger piece of pipe will be all right and can be left in until the mold is cast; this is not imperative, however. The cope being rammed up, remove the long pipe, then lift the cope off. Draw out the top or plate part of the pattern, finish the cope and the top of the core. Replace the cope, remove nut down at the top end of the pipe, screw the pipe into the center or hub of the arbor securely, put on the cast-



MAKING THIN CASTINGS.

iron binder *E* and bolt this to the brackets *F F*. Now back up the nut that is under the binder hard and firm against it. As this is to prevent the lifting of the core when being cast, right here is where the ounce of prevention can be used to great advantage. Now run down the nut above the binder tight, then remove the cope, bringing with it the core complete. Set the cope off upon horses or blocks and finish the remainder as usual. Close and clamp up ready to pour.

After pouring, when the casting is sufficiently cooled, dump it out and, with a little rapping to shake the core sand loose, the wooden wedges will come out, when the center of the anchor can be easily withdrawn, followed by the wings. Of course it will be readily seen that the parts of the anchor must be small enough to allow them to be drawn through the place provided therefor, unless, as in some instances, they are broken out and new ones made for each cast. These sketches are not drawn to scale, but simply to show the method adopted.

L. C. JEWETT.

Cooling a Gear Cutter with Compressed Air.

Editor American Machinist:

When I read your appeal to the shop men to write shop articles, I said to myself "That's right; what we want is shop articles and plenty of them." Then I thought about the necessity of thoroughly detailing everything in a shop article and of even then expecting it to be both misunderstood and criticised, and of the necessity for taking this good-naturedly. Well, while I was still revolving this matter in my mind, I received a letter in regard to my article on gear cutting in issue No. 8. Now, when I sent off that article I supposed I had made it so clear that everyone would see just what I had done, and immediately the writer of that letter wants to know how I applied the air, and whether I really used compressed air or only a blower. I guess that makes another on me, and I had better go into the matter more in detail.

The Lodge & Shipley shop is an up-to-date shop (though in my efforts at improvements I probably succeeded in convincing Mr. Lodge that I didn't think so), and it is piped for compressed air, which is used at a pressure of 60 pounds, not only for hoisting and drilling, but also largely for blowing chips and dirt out of, and off of, the work at both machines and benches; so when I decided to experiment, I had compressed air near at hand, and didn't need any blower to supply the air.

The gear cutter to which the air was applied was sometimes used for cutting steel gears, and to adapt it to this use it was fitted with an oil pump. A flexible metallic hose connected the pump to one end of a ⅜-inch iron pipe clamped to the carriage. On the other end of the iron pipe was a brass swing joint similar to those used in gas brackets. This swing joint carried a 3-16 inch brass tube about 4 inches long, which served as a nozzle and could be so directed, by moving the swing joint, as to project the stream of oil against the work at just the point where the cutter took hold of the metal, thereby cooling both work and cutter.

I simply disconnected the pump and connected the flexible hose to the air supply by means of a rubber hose belonging to one of our Boyer air drills, and let the compressed air, at 60 pounds pressure, play against the work and cutter, just as I would have let a stream of oil play against them if I had been cutting steel.

Say, you ought to have seen Mr. Lodge's smile when I brought him out from the office, to see "something new," and he saw that cutter running like a streak of greased lightning and chewing into those gears as though they were soft

butter instead of hard cast iron. Of course he was a little worried for the cutter, but we soon quieted his fears on that score. Practically none of the chips dropped into the chip box in the machine. Instead, they blew all over everything within 6 feet of the machine, and more particularly into the indexing mechanism. I found it necessary to put a bend like a spanner into the nozzle, so as to direct the chips as much as possible toward the other side of the machine. This, with the curtains over the slides and some galvanized iron guards, remedied most of the trouble from the large chips. The rapid rotation of the cutter produced a great quantity of fine iron dust along with the chips, and that dust was what prevented the complete success of the scheme, and made it necessary for me to add a suction to carry it off. I had a galvanized hopper, 4 inches wide and 10 inches high, made and fastened to the front of the machine (I call it front, though it may be the side; at any rate it isn't the end), opposite to the standard and close to the index wheel. A 4-inch galvanized pipe led up to the 7½-inch inlet pipe of the exhauster, which was located overhead. Now I see you want to know why I had a 4-inch pipe and a 7½-inch. Well, simply because there were four gear cutters in a row, and I connected each one of them with a 4-inch pipe to the 7½-inch overhead suction main. I also made permanent iron pipe connection to the machines for the air, instead of the hose at first used. Each air pipe had a 1-inch steam cock to shut off the air when cutting steel, and each suction pipe had a slide to shut off the suction.

I hope some maker will take this up and build a dust-proof gear cutter adapted to use air in this way. I am convinced that compressed air applied to a tube drill would be a valuable improvement in drilling cast iron. For a good many jobs of milling it could be readily applied; but here again the exhauster would be a necessary concomitant of the arrangement.

Detroit. L. O. DANSE.

The De Laval Steam Turbine Shafts

Editor American Machinist:

The article under the above title in issue No. 7, page 181, by E. Meden, shows the subject (as evidently considered by him and others) in a way, to me, simply astonishing. The action of the wheels being out of balance has no more effect toward destroying the shaft than if the shaft stood still and was weighted so as to bend it to the same amount. Whatever it is bent out of straight by the wheel revolving around its own center of gravity bends it in one direction, and there it stays until the wheel is nearly brought to rest. The shaft does not bend back and forth or round and round, but just bends to one side and revolves as a crooked shaft, a fact which certainly the man who tested one for crystalization could not have realized.

Syracuse, N. Y. JOHN E. SWEET.

Artistic Bronze Casting—French Sand.

Editor American Machinist:

The interesting articles on brass founding that have appeared in your periodical from time to time have no doubt been read with considerable interest. In the various classes of work produced by the brass and bronze foundries the same problems arise, and the same difficulties are encountered. The foundry producing the most common, everyday product has its troubles as well as the foundry producing a perfect cast of some statue or group; and so, also, has the foundry producing a *cire perdue* cast of some intricate undercut work. I might cite for example a laurel wreath, in which the adjacent undercut leaves are so close together that even the best French sand has not body enough to hold itself together when withdrawn from between the leaves. The progress of brass and bronze founding in our country has been a steady march forward to those who have been interested and observant of what has been going on around them. I recollect that, when an apprentice, the foundries in this country which could turn out a piece of false core bronze work without the most expensive sectional patterns were few in number indeed. To-day such work can easily be done in a dozen places in the city of New York, and even the crank who desires that the casting shall be produced so perfect that no tooling shall be necessary can be accommodated by the half-dozen foundries in New York city who are ready to do casting *a la cire perdue*.

To depart from our everyday mechanical grind and to dive into the artistic may not seem proper, yet how many of us are thrown in contact more and more every year with the making of things of decorative character. As Professor Sweet intimated some time ago, that the blacksmith who becomes aware of the fact that there is more work for him when he becomes familiar with decorative work, so would I say to the toolmaker and the molder that the field in the ornamental line is growing, and men who can overcome the difficulties presented in the molding of these more complicated pieces will certainly be satisfied with the results, as far as plenty of work and remuneration are concerned.

While there is a great deal of bluster about what can be done in "our foundry," it is a fact that, as a rule, when a job comes along out of the usual—let us say an ornamental job, having some undercut and intricate core not made easy by sectional patterns—then the boss is at a loss. Several years ago I had a contract to fill out West. A concern having a very large foundry was turning out for the firm with whom I was at the time about a ton of ornamental work every day or two, and the boss told me that, as yet, he had seen nothing in the way of casting, however complicated, that he could not produce at his foundry. One day an order came in for a nowel post; the square corners of the pedestal were decorated with a ram's head. There was nothing particularly difficult about the piece, and I was surprised when I received word that the piece couldn't be cast, as the pattern was not made correctly. A visit to the foundry proved that they could not make it, as the horns and ears would not draw. A march through the city's foundries, both iron and brass, proved to me that they could not make it. None of the people seemed to know anything about French sand, and as for *cire perdue* methods—well, I did not venture to broach the subject. I returned to the first firm and started to tell them about French sand, its peculiarities, etc., and when I told the proprietors that the sand can be cut into shavings there was a great laugh. However, they begged to have a sample to try; but when they get a sample they will also need a molder who can use it.

All sorts of schemes are proposed, as a rule, to stave off the use of French sand. Make it in sections and braze it together, is the "old man's" cry. The modern architect, however, has seen the product of foundries using French sand, and as a rule he is bound to have his work done as he desires it, even if it is necessary to have it done in some other locality. The brazing of bronze ornamental columns, pedestals, bases, etc., is certainly unsatisfactory to most first-class architects, and, as a rule, is not followed in good practice. While it is true that there are some bronze jobs right here in New York that are simply nightmares, most atrocious in construction and finish, it will be found as a rule that the aim is to reproduce a piece of bronze work bearing the stamp of high class work from start to finish. Some of the hurdy-gurdy, push-it-out chaps who frequently appear as bidders for high-class brass and bronze work, and who catch an occasional job on account of their low bids are usually satisfied with one trial. It usually turns out a bitter pill for both them and the architects, and they steer clear of future entanglements.

I have been informed that the sands found at Belleville and at Fontenay aux Roses, in France, are the most satisfactory sands used for the purpose of fine castings with good face. The peculiarity of French sand is at once apparent to the observer who watches the molder fitting and cutting his sections. The cutting of this sand, when prepared for molding, reminds one of the cutting of a substance that is anything but sand. In the words of one who was watching the process, "it cuts like cheese," and when the metal is poured the casting will prove the strength of the sand by a surface that is obtained by no other sand. There is rarely a wash noticed when using this sand.

Something over twelve years' experience as executive in a foundry in which we

tried Connecticut sand, Philadelphia sand, Albany sand, Windsor Locks and French sand, and also gave the system *a la cire perdue* an extended trial and in which we turned out from the plainest mechanical work to such work as Barye's smaller groups, the Tiger Hunt, Napoleon, Hound and Hare, Lion and Serpent, convinced me that if fine castings were desired with surfaces clean and sound, then French sand fills the bill. The endeavors of those interested in the advance of the art of brass and bronze founding in this country will be considerably strengthened by study and investigation in this direction.

JOHN G. NIEDERER.

Making Barrels for Cylinder Patterns.

Editor American Machinist:

I present herewith a mode of constructing barrels for steam and other cylinder patterns that are required to be in halves and to have core prints on each end. The heads are laid out and sawed in the usual way; eight half-heads being necessary for a pattern built according to these directions. A notch 2x4 inches is cut in the center of each head, to take a piece of that width and thickness that runs the full length of the pattern. This piece stiffens the barrel and is convenient for rapping and lifting it. The half-heads that make the ends of the barrel are doweled with two dowel pins each, as shown in Fig. 1, which also shows the heads glued and screwed to the 2x4-inch pieces mentioned above.

One-half of the barrel is staved up complete. The short staves that make the prints are put on first and the body staves last, as shown in Fig. 2. The joint of this half-barrel is planed up and the frame for the second half is placed on it, the dowel pins guiding it into place and steadying it. The second half is then staved up, starting at the joint on each side; this saves planing the joint of this half after the staving is finished. Fig. 2 shows the barrel completed, all but two staves, which are left off to show the construction more clearly.

Fig. 3 is the ideal skeleton core box. Its construction differs but little from those illustrated by me some time ago, but it is much "handier," as the sweep is drawn lengthways with a rabbet in the edge of the stave for a guide. This box is very popular with coremakers, in many cases being preferred to a full half-round box, so that it can hardly be classed with other boxes of this type, a make-shift.

HOBO.

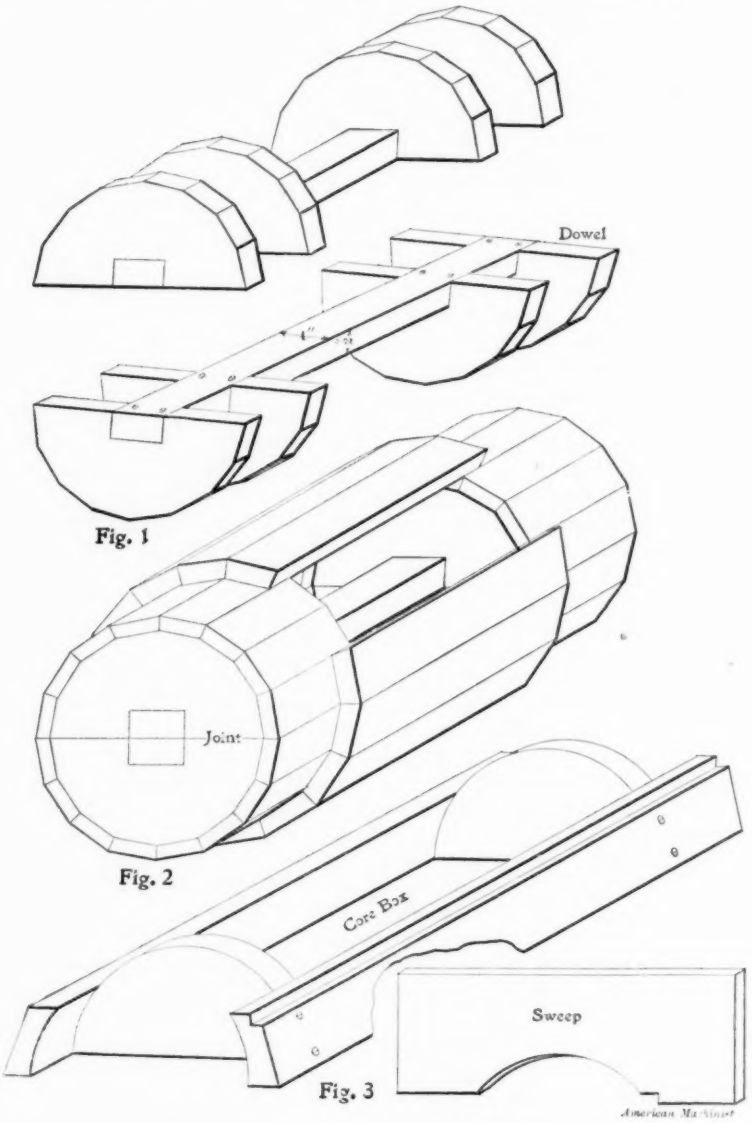
Machining an A-Frame on a 24-Inch Lathe.

Editor American Machinist:

We had to build a pair of vertical refrigerating machines of 18-inch stroke, each consisting of three bed-plates bolted together side by side, and supporting three vertical A-frames of box section below and with a central round cylinder base above, in a shop where the largest tools were a 36x36-inch planer and a 24-inch engine lathe. It was not possible or desirable to have the frames or other castings machined by other shops. The talent at command did not feel justified in attempting to bore the cross-head guides in the frames, and after that planing the feet square with the bore by setting the frames of the planer and carrying the facing tool on the planer table, especially as the floor of the shop was not of the best. It was therefore decided to both bore the slides and face the feet on the 24-inch lathe, and the work was done as follows:

Each side of the frame happened to be provided with two circular spots, to receive the ends of the round braces between the frames of the completed machine. The spots were first planed, the width of the legs of the frame at this point being less than the width between the planer housings, while the spread of the feet was about 5 feet. Parallel bars were made, of proper thickness to support the frame by these two circular spots, on the carriage of the lathe. The spots happened to come at the center of gravity of the frame, so that it lay level without special pains being taken to support either end. A tool block and slide were made to attach to the face-plate of the lathe, and by feeding the tool block by pin and star across the face-plate, the top of the frame for the cylinder to set on was readily faced off. The hole at the center of the top face was then bored to size by feeding the frame on the lathe carriage toward the face-plate. A centering bearing-piece was then set in the bored hole, and through this was operated the boring bar, the bar being attached by a flange and bolts to the face-plate and carried in a special tail bearing or steady rest on the ways of the lathe at its other end. By feeding the work along the lathe bed the cutting head on the bar easily bored the guides true.

This part of the work was all done at an efficient and desirable rate of speed;



MAKING BARRELS FOR CYLINDER PATTERNS.

but the facing off the feet was done at a rate only to be considered justifiable because of the substantial accuracy of the result. The lathe happened to be short, so that the bar projected 2 feet beyond the end of the bed, while the feet faces of the A-frame were nearly even with the end of the bed. A facing arm of proper length was made and bolted to the bar, and the tool-slide formerly used on the face-plate was fastened to the arm. The same star-feed (the pin being now fastened to the floor) was used. A small wood pulley was substituted on the line-shaft for the usual driving pulley in order to run the lathe slow enough; and the arm thus swept around in its circle at a sufficiently moderate speed to face off the feet of the frame to proper length, measured from the previously faced upper end. The spring of the unsupported end of the 5-inch boring bar was nearly eliminated by resting it on a V-block clamped to the table of an adjacent shaper. The first roughing cut left the faced surface slightly conical, owing to the increased spring of the arm with the tool at its extreme radius; but a finishing cut brought all to substantial truth.

The time consumed in this job of facing was not as serious as might have been supposed, because the lathe runner had only to start the machine and then could take up another job until time to shut down. It took over a minute for a complete revolution of the facing arm, and about thirty-six hours for two complete cuts across the foot faces; yet the labor-cost was measured by four or five hours at most, and, as the lathe could be spared at the time, this slow method was much to be preferred to depending on another shop for important parts of the machinery. The fact that there were six frames all alike brought the cost of rigging-up to a reasonable figure, when compared with the total cost of the work. On the whole, it may be said that the method adopted was quite justifiable in economy and accuracy.

S. H. BUNNELL.

Drill Press Speeds.

Editor American Machinist:

The article in No 51, 1900, "Some Curious Drill Press Speeds," is a matter that has been written about at different times, but I cannot recollect reading of any reason given for the practice, except that the designer did not know his business. I have had considerable experience figuring out cones and gears for lathes, drill presses, etc., and have always aimed to have the changes in speed even throughout, but have sometimes been tempted to make the fastest speed with the back gear in, as fast as the slowest speed open belt, so as to get more power at that point. No doubt your readers have had the experience of the slowest speed open belt being the right speed, but the power not being sufficient. I have thought of making the change more particularly in the case of drill presses, as the diameter of the largest drills used in a press is usually much less than the largest diameters turned in a lathe, thus giving the opportunity to make this seeming mistake and still have it possible to get speeds that are graded evenly, and by slight jumps from fastest to slowest, by missing this particular step with the back gear in. This may have been the reason for making the drill press with speeds, as Mr. Ridderhof describes it.

J. J. STURNS.

Galt, Ontario.

Improved Rule for Setting Dividers.

Editor American Machinist:

Below I give a rule for setting dividers by a Brown & Sharpe improved scale, which rule I believe will interest all die and tool makers.

Example—Set dividers to 1.769 inches.

$$1.769''$$
$$9$$
$$167$$
$$7 - 16 - 9$$

Cancel right-hand figure and subtract same from remainder. Cancel right-hand figure of remainder. To the right on line below set down first figure canceled. To the left set down the second figure canceled. Between them set down all remaining figures. The figure to the right represents the number of .011-inch spaces. The figures in the center represent the number of .100-inch spaces. The figure at the left-hand represents the number of .010-inch spaces.

FIG. 1. PORTION OF RULE FOR SETTING DIVIDERS.

$$9 \times .011'' = .099''$$
$$16 \times .100'' = 1.600''$$
$$7 \times .010'' = .070''$$
$$1.769''$$

This rule brings all numbers of spaces in order as the Brown & Sharpe rule is laid off, and applies to all figures where the dots are not used.

EDWARD DEAN.

St. Louis.

[For the convenience of readers we give a cut of the rule, on an enlarged scale, showing how it is laid off. This rule ought to be better known and more generally used than it is, and we believe it would be if the directions given for using it were a little more easily understood. By its aid work can be laid off with very great accuracy, and it may be worth while to supplement Mr. Dean's letter with some additional explanation of what we believe to be a very convenient method of using it. The catalog of the makers of the rule does not seem to make it readily understandable.

The plan we propose is that each workman who uses one of these rules make for himself two scales similar to those shown in Figs. 2 and 3, which need not be accurately laid off, but may be roughly done with a pencil. These scales or diagrams represent (enlarged) the end of the rule in question, and have on them figures which enable the proper lines or the proper line and dot required for any setting of the dividers to be very readily selected.

Reference to the engraving of the rule (Fig. 1) shows that the last inch space at the right is graduated in hundredths of an inch up to 80 hundredths or 800 thousandths; the first or left-hand one of the special lines at the right being just .800 inch from the next inch division to the left of it. It is therefore marked on the diagram, Fig. 2, with the figures representing this distance, as shown at the top of the line on the diagram. The next line to the right is .011 inch from the first one, and its distance from the same 1-inch division line is therefore .811 inch, which is also marked as indicated on the diagram, and so on all the way across, the distance of the last line of this series being, as indicated, .899 inch.

This line of figures is to be used for all settings of the dividers to distances greater than 1 inch, and in doing this it is necessary only to subtract from the distance to which the dividers are to be set those figures of the upper line which will make zero for the third decimal place in the remainder, or, in other words, will leave the remainder in units of hundredths or tenths of an inch. Thus, for instance, suppose we wish to set the dividers to one-thousandth over 1 inch. This is expressed in figures thus: 1.001 inch; the figure in the third decimal place being 1. Now we must subtract from these figures that figure of the upper series of the diagram which will reduce this 1 in the third decimal place to 0; and, looking over the figures, we see that the first one we come to that will do that is .811. We therefore make the subtraction thus:

$$1.001''$$
$$.811$$
$$.190''$$

This means simply that of the total distance we require we are to take eight hundred and eleven thousandths of it by taking the first one of the eleven-thousandth spaces plus the distance from the first eleven-thousandth line to the inch graduation x, and that there are then left, as shown by the subtraction, nineteen hundredths (.19 inch) to be added to get the whole distance, and we get these addi-

tional hundredths by going to the left of the x division the required number of graduations. In other words, we simply set one leg of the dividers to the second eleven-thousandth line, or line 2 on the diagram, and the other leg to the left of line x as many graduations as are indicated by the remainder after the subtraction is performed.

Similarly, suppose we wish to set to 1.437 inches. By inspection of the figures

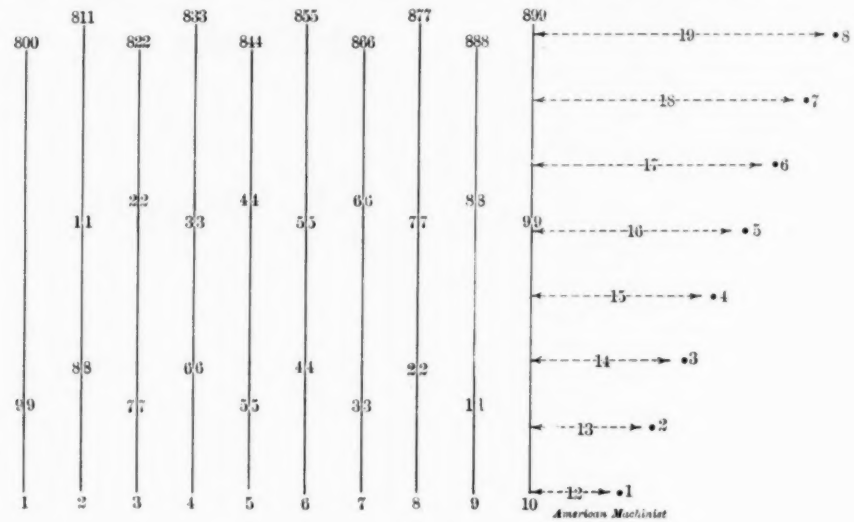


FIG. 2.

we see that we must use in subtracting the figures .877 of the diagram, and subtracting as before we have:

1.437″
.877
.560″

and we see that one leg of the dividers is to be set on the eighth of the eleven-thousandth lines, and the other leg 56 hundredths to the left of the line x.

Settings for distances less than 1 inch

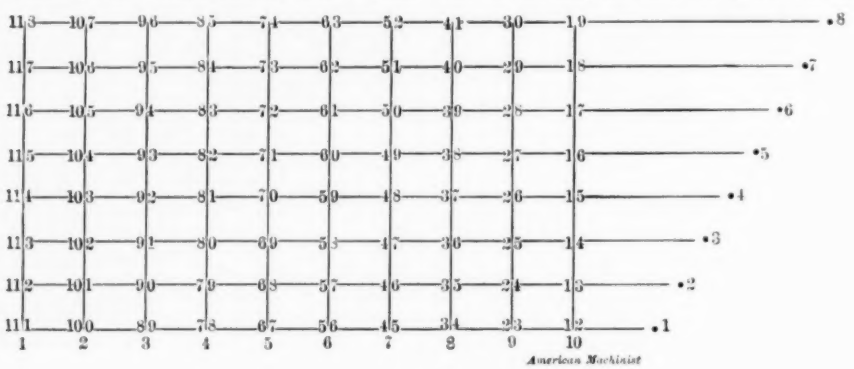


FIG. 3.

and that are multiples of .011 inch are of course obtained directly from the diagram, Fig. 2, and for getting such settings it seems to be most convenient to use a series of figures reading from right to left, as shown, below the others, these figures representing the distances of the various lines from the last one of the eleven-thousandth lines; but for the majority of settings below an inch the diagram Fig. 3 is most convenient. In this diagram the eleven-thousandth lines are numbered at the bottom from right to left and the dots are numbered from the bottom upward, as will be seen. The figures at any intersection of the vertical and horizontal lines show the distance from the given line to the dot opposite the given horizontal line. Beginning at the bottom of line No. 10, we have, first, the distance .012 inch, and by following upward on this line we get distances increasing by one-thousandth for each successive horizontal line, until at the top we have .019 inch. The next higher number on this diagram is at the bottom of line No. 9 and represents .023 inch, so that we see that there is a gap to be filled consisting of the distances .020, .021, .022 inch. There is a similar gap between the distance represented at the top of any given line on the diagram and the figures at the bottom of the next lower-numbered line, this gap consisting always of three figures or distances. Some of the figures included in these gaps will be found among the middle series of figures on diagram Fig. 2, which represent the distances of the given line from the first eleven-thousandth line, and where a figure missing on Fig. 3 is found in this series, the distance is of course readily obtained. Returning again to the figures given above that are not found on Fig. 3, we of course readily see that to get .020 inch we have only to take two of the hundredth-inch spaces on any part of the scale; to get .021 inch it is obvious that we may take the last hundredth-inch space on the scale and the first .011-inch space, which added together make .021 inch, and the .022-inch space is found on diagram Fig. 2. We then commence at the bottom of the ninth line, and going upward to the top get all the distances up to and including .030 inch, and we then find that between this point and the next distance given at the bottom of line No. 8 there is again a gap to be filled, and we may make a rule for all these numbers. The rule will be very simple, and is as follows: From the desired setting take the number of the middle series on diagram Fig. 2, which will make the third decimal place in the remainder 0, then set one leg of the dividers to the line corresponding to the figure subtracted, and the other leg to the left of the left-hand eleven-thousandth mark as many hundredth spaces as are indicated by the remainder after the subtraction is made. Thus suppose we wish to set to .032 inch. We do not find this distance on either diagram, so we subtract according to the rule, thus:

.032
.022
.010

and we see that one leg of the dividers is to be set on line No. 3 of Fig. 2, while the other leg takes in one of the hundredth-inch spaces, as indicated by the remainder. Again, suppose we wish to set to .097 inch, we subtract thus:

.097
.077
.020

and thus see that one leg of the dividers is to be set in the eighth line of Fig. 2, while the other leg takes in two of the hundredth-inch spaces.

Either one or two hundredths will always be included in these last named settings, and it is of course obvious that by making another diagram giving the distances of the various eleven-thousandth lines from the last two hundredth graduations, all the gaps would be filled in, and any figure below 1 inch could be found on one or the other of the three diagrams. Those who may have much use for the scale may find it worth while to make such a diagram, but we have not thought it necessary to do so here. As previously stated, these diagrams need not be accurately laid off, and the method described for using them, while it may seem tedious to describe it, is not so in use; the actual operations of getting any desired setting being very simple and readily performed. —Ed.]

German Imitations of American Goods.

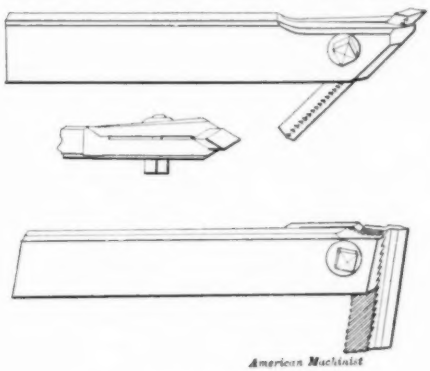
An illustration of the propriety and the beneficent effect of marking all imported goods with the name of the country in which they are made is afforded by the experience of countries where this practice is not enforced. United States Consul Berg writes from Gothenburg, Sweden, as follows:

"My attention has been called to the forks sold by a wholesale hardware dealer of this city as American products. This fork, an inferior imitation of the original, is sold as an 'American manure fork' at a price much lower than that for which a genuine American fork can be offered. This is only one sample of the many German imitations offered for sale in Sweden and represented to be 'best American goods.' This, of course, does great harm to the American trade, as the buyer will soon discover that he has bought an article not worth the money, and will blame the American manufacturer. It causes prejudice against everything of American make. Sweden has no law compelling the mark of origin to be placed on imported goods, and it is very easy for German exporters and Swedish importers to flood the market with this kind of goods. The Swedish law says simply that foreign-made imported goods shall not be marked, stamped or branded so as to make the purchaser believe that the goods were manufactured in Sweden."

Some New Things.

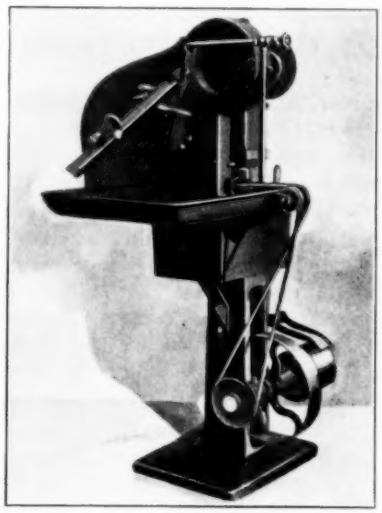
A NEW LATHE TOOL.

The cut shows two forms of a new style of lathe tool with adjustable and renewable cutter, the upper tool being a "diamond-point" and the other a V-thread tool. As each cutter has oblique serrations on one side of it, with corresponding



A NEW LATHE TOOL.

teeth on the surface with which it contacts on the holder, it is held securely without overstraining the screw and by using the successive steps the hight of the cutting point is minutely adjusted as required. The V-tool is offset to the left side, so that in cutting right-hand threads it can be worked close up to a shoulder. Cutters are furnished of either self-hardening or tempered tool steel. The tool is made by the Kirkpatrick Saddle Company, Springfield, Ohio.



THE HEALD WET DRILL GRINDER.

Our readers are familiar with the special points of the drill grinder made by L. S. Heald & Son, of Barre, Mass., and these need not be repeated, but we give an illustration of their latest wet grinder for drills.

This new wet grinder has for its foundation the regular style of drill grinder of the latest pattern, namely, the one which has the double taper bearings with the belt pulley between them, which was illustrated in our issue No. 1, 1901. The emery wheel is protected with water-guards to keep the water exactly where it belongs and not allow it to be thrown over the floor or the operator. The water is delivered to the wheel just above where the work is being done, and in this way the full benefit is obtained from the water supply, which is not thrown off by centrifugal force before it reaches the grinding point.

A large water-pan is provided, which is mounted close up under the work and extends out far enough to be under the drill holder in all positions. From this pan the water drains into a reservoir beneath, which has two compartments—one for a settling chamber and the other containing clear water, in which the centrifugal pump which furnishes the water supply is submerged.

This centrifugal pump is mounted on a vertical axis, the advantages of which are many. First, it requires no stuffing-box, which is apt to be a source of trouble, owing to the tendency of the water to work out through it; and when this water contains grit, as it frequently does, the packing is apt to be injured and the stuffing-box gets leaky and cut out. All this trouble is avoided by using a vertical axis, and by being submerged the pump is always primed.

The bearings are entirely above the water, and their proper lubrication is a very simple matter. This centrifugal pump is driven, as will be noticed, by a round belt coming up in the rear of the machine from a pulley on the countershaft, over the idler pulleys to the vertical shaft of the pump. The supply of water may be regulated by the valve shown in the angle of the pipe, and may be shut off entirely when desired, thereby using the wheel dry, as in the regular machine.

Legal Notes.

PRINCIPLES INVOLVING THE RESPONSIBILITY OF EMPLOYERS FOR THE SAFETY OF THEIR WORKMEN.

The following are abstracts chiefly from recent decisions in the higher courts of various States. In general they are indicative of the law throughout the country:

The risks and dangers assumed by an employee are such as are incident to his employment, such as are known to him, and such as are obvious and patent. (Pa. 9 Dist. Rep. 291.)

To show that an employee assumed the risks connected with the operation of a machine it must appear, not only that a defect was patent, but that he knew the danger of operating it in its defective condition. (Minn. 92 N. W. Rep. 981.)

A minor cannot recover for an injury received while working a machine when the danger of the machine is such as can readily be seen, and he was duly instructed in its use, and the machine was in good condition. (Pa. 17 L. L. Rev. 247.)

Where an employee is injured while obeying the orders of his employer to perform work in a dangerous manner, the employer is liable, unless the danger is so imminent that a man of ordinary prudence would not incur it. (88 Ill. App. Ct. Rep. 169.)

In order to recover for defects in the appliances of the business, the employee must establish by proof three propositions: First, that the appliance was defective; second, that the employer had notice or knowledge of such defect, or should have had; third, that the employee did not know of the defect, and had not equal means of knowing with the employer. (87 Ill. App. Ct. Rep. 551.)

It is incumbent on an employer to exercise ordinary care to provide and maintain a reasonably safe place and reasonably safe machinery and appliances in which and by means whereof an employee is to perform his service. (U. S. Ct. App. 103 Fed. Rep. 265.)

It is not only the duty of an employer to warn his employee against the danger that lies in the unskillful or careless operation of machinery involved in his employment or task, but he should also give suitable instructions as to the manner of using the same so as to avoid danger. (13 Pa. Sup. Ct. Rep. 219.)

While it is settled law that an employee assumes the ordinary and apparent risks

of his employment, he does not assume the risk from defects in the plant itself, which the employer is bound to make and keep in a reasonably safe condition. (Me. 46 Atl. Rep. 804.)

An experienced workman of mature years cannot continue to operate a machine, which he knows is dangerous without assuming the risk, simply because the employer has assured him that it is safe, when the workman has just as much knowledge of the danger arising from its use as the employer. (Mich. 82 N. W. Rep. 797.)

The burden of proving that an accident arose out of and in the course of the workman's employment lies on the employee; but the burden of proving serious and willful misconduct lies on the employer. (Eng. 80 L. T. 317.)

If the negligence of the employer operates as a concurring and efficient cause of an injury to an employee, his liability will not be relieved by the negligence of fellow-employees also concurring. (88 Ill. App. Ct. Rep. 162.)

To constitute fellow-servants they must either directly co-operate in the particular business so that they may exercise an influence on one another promotive of proper caution, or their duties must be such as to bring them into habitual association so that they may exercise such influence on each other. (88 Ill. App. Ct. Rep. 169.)

Inquiry for Machinery.

(144) Wanted, names and addresses of manufacturers of machines for making taper wood plugs from ⅜ to 5½ inches diameter, 1 inch long.

Personal.

Tom L. Johnson, the well-known inventor, manufacturer and street railway man, has been nominated for Mayor of Cleveland by the Democrats.

C. L. Libby, formerly of Bridgeport, Conn., and for the past three years superintendent of the machine-tool department of Ldw. Loewe & Co., of Berlin, is visiting his friends here and looking about among the shops.

On Washington's Birthday the University of Pennsylvania conferred upon Rear Admiral George W. Melville, engineer-in-chief of the United States Navy, the degree of Doctor of Science, "for his services in heroism, intellect and science."

Edward P. Hetherington, who was formerly with the establishment of Muir & Son, Manchester, England, and is now a director in the establishment of John Hetherington & Sons, Limited, machine tool makers, of the same city, has been in this country for some time past and sailed for home on February 16.

Charles W. Sponsel, who for the past six years has been assistant superintendent of The Capewell Horse Nail Co., Hartford, Conn., has resigned and accepted the position of superintendent of the Eddy Electric Company, Windsor Conn. Mr. Sponsel was elected one of the directors of the company and has also acquired a personal interest in the business.

Obituary.

Emory C. Whiting, a patent attorney of Hartford, Conn., died there Feb 13.

B. B. Vandeusen, superintendent of the Remington Typewriter Works, at Ilion, N. Y., died February 13. He had been engaged in mining in Utah, where he lost an arm, and went to Ilion eight years ago.

Edwin Green, who was for fifty-five years employed at the Neafie & Levy Shipbuilding Company's Works, Philadelphia, and for many years foreman of the pattern shop, died February 20, seventy-one years old. He gave up active work in 1895.

Charles W. Bitting, superintendent of the machine-tool department at the Pedrick & Ayer Works, Philadelphia, died in that city February 20, sixty-four years old. He served in the navy during the Civil War.

Otto W. Meysenberg, president of the Rodger Ballast Car Company, and also of the Siemens-Halske Electrical Company of America, and ex-president of the Wells-French Car Manufacturing Company, died at Alma, California, February 11, fifty-two years old.

Charles H. Redmond, sixty-nine years old, one of the oldest employees of the Domestic Sewing Machine Company, and a foreman of one of its departments since the establishment of their factory in Newark thirty years ago, was instantly killed by a bicycle accident at Roselle, N. J., February 23.

New Catalogs.

The United States Metallic Packing Company, 427 North Thirteenth street, Philadelphia, Pa., publishes a small catalog of packings for marine and stationary engines. It is of standard size, 3½x6 inches.

Fay & Scott, Dexter, Me., have sent a catalog of turrets, including a new patented carriage turret, a tool-post turret attachment consisting of six tool-posts, turret heads, for use on engine lathes, etc. It is 6¼x3½ inches.

The Jeffrey Manufacturing Company Columbus, O., has sent us Catalog 56, describing chain belting steel cable and an extensive line of elevating and conveying appliances adaptable for handling material of all kinds. It is 5x7½ inches.

"Graphite as a Lubricant, Scientifically and Practically Considered, also its Manifold Usefulness as an Accessory for Engineers and Mechanics. Seventh edition, revised." This is published by the Joseph Dixon Crucible Company, Jersey City, N. J., and is 5¼x6¾ inches in size.

The George Gorton Machine Company, Racine, Wis., has published a pamphlet devoted principally to its No. 4 disk universal flat surface grinder (18-inch disks) for plain surfaces and segments of cylindrical surfaces. The description is aided by line cuts of the details. Size, standard, 9x6 inches.

Fred'k H. Gliem & Co., successors to Lucas & Gliem Machine Works, Ridge avenue and Hamilton street, Philadelphia, Pa., have sent us a catalog of cold saw cutting-off machines. The machines shown comprise bar, universal, steel foundry and crank shaft saws, each in different sizes, and automatic saw-sharpening machines. Size of catalog, 9x6 inches.

Manufacturers.

D. M. Mills, Oswego Falls, N. Y., will build a three-story pump factory.

An addition is being built to the Jackson County Mills, Scottsboro, Ala.

The negroes of Jackson, Miss., are raising subscriptions for a cotton mill.

The Wilmington (Del.) City Railway Company will build a new power-house.

It is understood that the Syracuse (N. Y.) Arms Company will enlarge its plant.

W. F. Potts, Son & Co., Philadelphia, Pa., will build an addition to their foundry.

A plant will be established for the American Shipbuilding Company, in Halifax, N. S.

Clyde & Dyett, owners of the Electric Wire Works, Rome, N. Y., will erect a new building.

Weldon & Kelly, Pittsburgh, Pa., are in the market for a pipe-cutting and threading machine.

The M. Campbell Fanning Mill Company has bought land at Detroit, Mich., and will rebuild.

The works of the Ludlow Valve Manufacturing Company, South Troy, N. Y., will be enlarged.

M. J. Johnson and Fred M. Aiken, of Lima, O., will build a pulp and paper mill at Petoskey, Mich.

An official of the Illinois Central announces that the road will erect new car shops at Carbondale, Ill.

A one-story iron foundry, 50x160 feet, will be added to the plant of H. C. Fox & Co., Philadelphia, Pa.

The Wisconsin Machine & Foundry Company has been incorporated with a capital stock of $25,000.

The Reading (Pa.) Wood Pulley Company has taken out a permit for an additional story to its plant.

The Admiral Bicycle Lamp Company, Columbus, O., will build a plant in Marysville, O., and move there.

The Konantz Saddlery Company, East Sixth street, St. Paul, Minn., will build a five-story addition, 50x100 feet.

The Michigan Lake Superior Power Company is building a 50,000 horse-power canal at Sault Ste. Marie, Mich.

An addition is being built to the Huntsville (Ala.) Foundry & Machine Works, and much new machinery will be installed.

It is reported that the National Glass Company, Pittsburgh, Pa., will rebuild the tumbler plant in Rochester, Pa., in a fine way.

The T. C. Entwistle Company has been incorporated in Maine to manufacture and deal in machinery; capitalized at $100,000.

The Rockland (Me.) Machine Company will erect a steel building for its boiler shop, blacksmith shop and brass and iron foundry.

The Bowie County Oil Company has been organized with $50,000 already subscribed to erect a cotton oil mill at New Boston, Tex.

An addition, 50x150 feet, six stories, will be built to the Southwark (textile) Mills, Eighth and Tasker streets, Philadelphia, Pa.

An addition, 35x47 feet, will be built to the tin plate plant of the N. & G. Taylor